TECHNICAL NOTE NO. LWL-CR-02F71A

40mm FLOATING FLARE DEVELOPMENT

Final Report Contract No. DAAD05-72-C-0179

AMXBR-LB (Bldg. 305)
ABERDEEN PROVING GROUND, MD. 21005

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March 1973

COUNTED IN

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U. S. ARMY LAND WARFARE LABORATORY

Aberdeen Proving Ground, Maryland 21005

20080922026

CR-02F71A

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# ABSTRACT

The 40mm Floating Flare can be launched from either the M79 or the M203 Grenade Launcher and provides troops with a standoff capability for marking a target or position in inundated areas during hours of darkness. The flotation capability is achieved by a flare-inflated, donut-shaped "ballute" which also acts as an aerodynamic decelerator to prevent the units from burying in mud or snow at impact.

The objectives of this program were (1) to improve the color output of the green flare, (2) to improve the transfer from the first fire (ignition) mix to the main flare mix (all colors...red, yellow, and green), and (3) to fabricate quantities for engineering design testing and field evaluation. The specific objectives were achieved during the course of a three-phase effort and a total of 1528 cartridges were delivered to the Government.

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## FOREWORD

This report was prepared for the U. S. Army Land Warfare Laboratory, Aberdeen Proving Ground, Maryland, by Chemtronics, a Division of Airtronics, Inc. This report presents the results of the program conducted under Contract DAAD05-72-C-0179 during the period of February 1972 through March 1973. The LWL Contract Technical Supervisor was Mr. Neal C. Wogsland. Contributors to the work reported herein not listed as authors were Mr. D. Campbell and Dr. C. D. Alley.

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## INTRODUCTION

The objective of this program was to continue the development of the 40MM Floating Flare, especially to improve the color output of the green flare and to improve the transfer from the first fire (ignition) mix to the main flare mix (all colors), followed by the fabrication of quantities for engineering design testing and field evaluation. This grenade will broaden the Army's flare capability to include marking a target or position in inundated areas during hours of darkness.

The primary technical requirements for the floating flare as specified in the Statement of Work of Contract No. DAAD05-72-C-0179 was to provide a "greener" green flare, with "stoplight green" as the development goal. This investigation could have included consideration of using a shorter signal duration to determine if an acceptable tradeoff could be achieved. The second major emphasis was to improve the system reliability by improving the ignition transfer from the first fire to the main flare mix. The other design and performance goals, which were basically the same as those stated in Contract No. DAAD05-71-C-0191, are as follows:

- The 40MM Floating Flare shall be developed as a 40MM cartridge, with all components assembled as a single unit.
- This flare shall be designed for delivery from both the M79 and the M203 Grenade Launchers.
- This flare design shall incorporate the 40MM Cartridge Case XM195 for the launch system.
- 4. Flare colors required are red, green, and yellow.
- 5. The flare design shall incorporate a flotation device of the ballute type, which shall be fabricated from a material capable of withstanding the high temperatures of the burning flare mix.

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- 6. The cubic measurements shall be the same as those of the 40MM Floating Smoke Marker. The final assembly length shall not exceed 5 1/4 inches.
- 7. The projectile and total cartridge weights shall be consistent.
- 8. The cartridge shall be man-air transportable and have paradrop capability.
- 9. The cartridge shall be expendable.
- 10. The recoil momentum produced by the flare cartridge shall not exceed 4.0 lb-sec when fired from the M79 Grenade Launcher.
- 11. The flare cartridge shall be capable of operations in climatic conditions covered by Categories 1, 2, 5 and 6, of AR 70-38 dated 5 May 1969. Operation under all environmental categories is desired.
- 12. The flare delay element (fuse) shall initiate the signal emitting pyrotechnic before impact and preferably near the top of the trajectory when the flare is fired for maximum range.
- 13. Ballute inflation shall be complete between the time of separation of the payload from the projectile body and impact onto the water's surface when the flare is fired for maximum range.
- 14. The flare shall be capable of floating and functioning on mud or water of any depth and under all weather conditions.
- 15. The flare shall have a minimum range of 250 meters; 300 meters would be desirable.
- 16. The pyrotechnic mix shall produce a visible signal for a minimum of 1-1/2 minutes. (Note: See previous statement on possible tradeoff.) Duration shall be measured between the time of payload ignition (at

separation from the projectile body) to burnout after impact. The signal intensity and color shall be relatively uniform during this interval.

- 17. The flare signal shall be visible, and the color identifiable from an observation distance of at least 3000 meters from a minimum altitude of 1000 feet on a clear night.
- 18. The flare shall operate with 95 percent reliability in inundated areas.
- 19. The flare cartridge should be impact insensitive to small arms fire.
- 20. The flare cartridge shall have a storage shelf life of a minimum of five years.
- 21. Human Engineering Characteristics: Require no special training and complete safety in operation.
- 22. Maintenance Concept: Require no maintenance other than visual inspection prior to use.
- 23. Priority of Characteristics: reliability; performance.

The design of the floating flare is shown in Figure 1. Figure 2 illustrates the operation of the floating flare. The 40MM Flare may be launched from either the M79 or the M203 40MM Grenade Launcher. Approximately five seconds after the firing, the output of the fuse delay ignites the flare mix first fire. The resultant pressure generated inside the projectile body releases the snap joint on the ogive, thereby ejecting the ballute/flare canister assembly from the body of the projectile. Gases from the flare mix inflate the ballute instantaneously. The inflated ballute, acting as an aerodynamic decelerator, slows the descent rate of the flare. At the reduced descent rate and with its large frontal area, the flare will impact so gently in shallow water that it will not bury itself in soft mud below the surface. The design improvements of the floating flare, the flare compositions, and overall performance parameters are described in detail in the development sections.

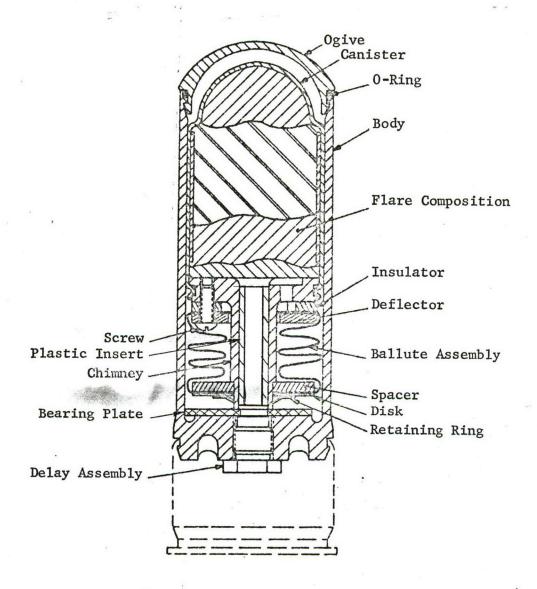


Figure 1 - 40mm Floating Flare Cross Section

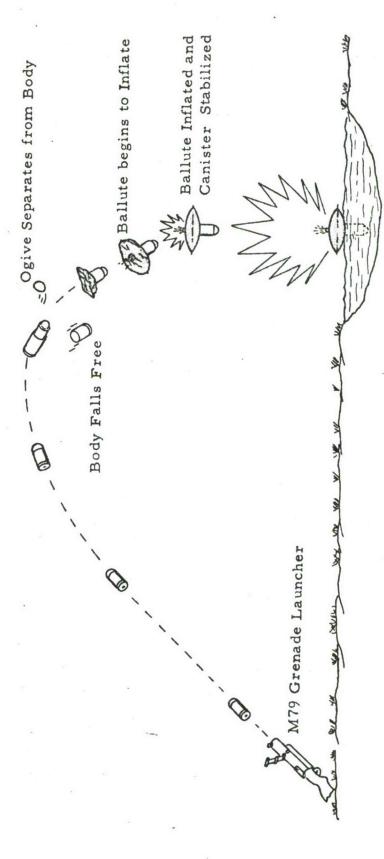


Figure 2 - 40 mmFloating Flare Sequence of Operation

### CONCLUSIONS

The program objectives were achieved.

The green flare composition was sufficiently improved that this flare was visible and recognizable to a range in excess of 3000 meters for approximately 90 seconds, as were the red and yellow flares. The 90-second burn time was achieved with all colors after a modification of the red composition that increased its burn by about 10 seconds.

Reliability (all colors) was improved by increasing the quantity of first-fire (ignition) mix from 2.25 grams to 3.00, by reducing the amount of teflon in the ignition mix by 75%, and by incorporating a 4-gram intermediate mix composed of 50% ignition mix and 50% flare mix. During the final test series of 53 cartridges, there were no failures attributable to this segment of the ignition train. The two failures that occurred were attributed to failures of the pyrotechnic delay.

Additional improvements in performance and reliability were achieved by changing to a full-length plastic chimney insert. This insert eliminated slag accumulation in the chimney during burning, thereby providing smoother burning (a more uniform flame) and preventing overpressurization of the ballute, which formerly had caused ruptures and premature sinking. As a further improvement, the break strength of the thread used to stitch the ballute was increased from 1.2 pounds to 3 pounds.

More than 400 units were tested during this program. These included green - flare-composition laboratory static tests, night visibility tests, and development and qualification tests. Outdoor tests involved both static tests in water and flight tests using an M79 Grenade Launcher.

A total of 1528 cartridges were delivered to the Government. The 40 Phase I units (20 green, 10 red, and 10 yellow) were for night visibility and reliability tests, the 300 Phase II units (100 of each color) were for engineering design and safety evaluation testing, and the 1188 Phase III units (396 of each color) were for field evaluation by user troops.

# HARDWARE DESIGN

### 1. GENERAL

The changes made to the design of the hardware during this contract effort are discussed in detail in the subsequent paragraphs.

#### 2. BODY

The body called for in the data package and used previously on the Floating Flare round is made per Drawing 9245765. This body is not considered the standard now due to upgrading of the manufacturing tooling. The body's reduced barrel O.D. is now formed during or immediately after the basic impact extrusion operation. Formerly this reduced barrel diameter was made by a secondary machining operation. The only dimensional change in the new body is the taper angle between the forward land and barrel. This surface is now a blend versus the 30 degree angle used on the old design. With agreement of the LWL project officer, the purchase order for the bodies was amended to reflect the new standard configuration and an alteration notice (AN) was written against the assembly drawing, 040091000, allowing the optional use of alternate Picatinny Arsenal bodies 9243900 or 9255778.

#### 3. BALLUTE

The vendor that was punching out the ballute pieces reported difficulty in preventing tearing between the I.D. and the three screw holes. From a review of the design, it appeared that the I.D. on the -2 and -3 components could be reduced from .720 + .030 inches to .65 - .05 inches. This would increase the material web between the I.D. and the three screw holes from a minimum of .025 inches to a minimum of .07 inches. In addition, the three .12 R cutouts in the I.D. didn't appear to offer any advantage to the design. Therefore, the I.D. was redimensioned and the .12 R cutout deleted on the drawing.

Because of random failures in the ballute stitched seam resulting in premature sinking, the thread size was changed from 70/2 per V-T-276 Type IA2 to 30/3 per V-T-276, Type IA1. In addition, the stitching per inch was reduced from a minimum of 25 to 15 to 20 because the closer stitched seam damaged the ballute material.

#### 4. OGIVE

After several discussions with previous program officials and the ogive vendor, it was concluded that the ogives supplied on previous programs were made by blending 0 percent and 40 percent glass filled Lexan. The drawing calls for a 10 percent glass content in the Lexan. It was noted on the previous programs that there was a large variation in the rigidity of the ogives. This variation causes problems in the retention of the ogive in the gun barrel and subsequent ejection at delay burnout. The vendor stated that the reason for the blending of 0 percent material with 40 percent material was the fact that it was cheaper for small orders and the lead time from the material supplier for preblended material was excessive. The material supplier was contacted and asked about the advisability of a molder blending glass filled Lexan with unfilled Lexan. He said it would not work because different surface coatings are used on filled and unfilled materials. These coatings prevent proper mixing of the materials in a mold. Another problem was the ogive drawing 040055013 called for green colored Lexan by the designation MVCL 6167. The proper callout for natural colored 10 percent glass filled Lexan is 500-131.

### 5. DELAY

In an attempt to use as many standard components as possible in the 40MM Flare the Picatinny 40MM delay was evaluated. This delay proved highly successful and was used throughout the program. An AN was submitted on the top assembly drawing number 040091000 to allow the use of the Picatinny Arsenal delay 9243885.

Only one problem was encountered with the delays on this program and that was traced to a manufacturing technique. These delays failed to ignite the flare mix first fire. X-ray examination showed a thin layer of delay output charge between the two pressed increments. Apparently the press ram was inadvertantly depositing some of the output mix from the previous delay onto the top of the first increment of the next delay. Twenty new delays were made with the operator wiping the ram clean after pressing each delay. Tests of these delays showed the problem was corrected by this new procedure.

#### 6. CHIMNEY

Probably the most significant improvement in performance of the hardware was made by the simplest design change. Two modes of ballute failures were observed. The most common failure was caused by slow inflation of the ballute immediately after ejection from the body. The aerodynamic forces caused the relaxed ballute to curl around the orifice of the chimney and thereby allowing the hot flame of the flare to burn a hole in the top of the ballute. The other mode of failure was simply an overpressure of the ballute stitching. All the colored flares experienced pressure increases during the early phases of burning due to slag accumulating in the chimney. The problem was especially severe with the green units and often resulted in failure of the ballutes and subsequent sinking.

In an effort to determine the reason for the slag accumulation in the chimney, units were made and flight tested with the plastic insert in the chimney extended the full length of the chimney. It was expected that the slagging would get worse due to a theory that the char of the insert acted as a catalyst for the solid components of the exhaust gases. However, the opposite occurred. The extended insert eliminated the slag accumulation and caused the ballutes to inflate faster. The char of the insert apparently prevented the char from bonding to the wall of the chimney. This change was incorporated on the Phase II and Phase III delivery rounds.

## FLARE COMPOSITIONS

#### 1. GENERAL

The flare charge design consists of an ignition starter mix, an intermediate mix and the main flare charge, all pressed simultaneously in the listed order.

The charge is a single end burner 1.29 inches in diameter and 2.19 inches in length. The following table shows a comparison between the various colored flares.

	Red	Yellow	Green
Ignition Composition Weight (gm)	3	3	3
Intermediate Charge Weight (gm)	4	4	4
Flare Mix Weight (gm)	65	56	65
Burning Surface Area (Sq. In.)	130	1.30	1.30
Pressed Density (gm/cc)	1.80	1.57	1.80
Average Burn Time (Sec)	88	100	88
Average Burn Rate (In/Sec)	.025	.022	.025
Press Pressure (lbs/sq. in.) 10,00	0-15,000	5000	5000

The three charge components were developed through an extensive series of tests listed in the Appendixes and discussed in Section IV. Details of the chosen elements of the flare charges are discussed in the following paragraphs. Note that the intermediate charge was not used in the previous feasibility program and the yellow flare mix was not changed during this program.

#### 2. IGNITION COMPOSITION

The Boron Potassium Nitrate ignition mixture gave generally excellent results throughout the duration of the program. However, the initial weight of 1.0 gram used on the first units was increased to 3 grams early in the program to improve the ejection of the ogive and to decrease the inflation time of the ballute. Late in the program reproducible ignition of the ignition charge became a problem and the teflon binder was reduced to aid this problem. The two compositions are given in the following table.

	Percent	by Weight
Components	Old	New
Boron	19.2	22.6
Polytetrafluoroethylene	18.2	4.6
Potassium Nitrate	57.6	67.8
Lupersol DDM	. 05	.05
Resin Polyester	4.95	4.95

#### 3. INTERMEDIATE CHARGE

Because some ignition transfer failures between the ignition composition and the flare mix occurred in the earlier feasibility program, an intermediate charge was used during this program. The intermediate mixture consisted of a blend of 50 percent by weight ignition charge and 50 percent by weight flare mix. Initially only two grams of mix were used, however during this program this was increased to three grams then to four grams as a result of random ignition transfer and ballute inflation problems

#### 4. FLARE MIX

The primary technical objective was to improve the color quality of the green flares. The baseline formulation, which served as the performance standard, was developed late in the previous feasibility program. Initially twenty six additives were tried, however all of the additives reduced the flare burn time considerably below the 90 second requirement or caused excessive chuffing or were too high in flame temperature. Another problem which occurred with some of the additives was incompatibility with other mix ingredients. In fact the additive that gave the best color improvement, chromic chloride, sometimes reacted with the magnesium during mixing and pressing. After the additives failed to produce the desired results of increasing both intensity and color quality, the baseline formulation was optimized. This optimization resulted from a decrease in the barium nitrate by 10 percent, a removal of the ammonium chloride. and a 5 percent increase in both the ammonium perchlorate and binder and a 10 percent increase in the magnesium content. Both the baseline (old) formulation and the new formulation are given in the following table:

	z creent b	y weight
Components	Old	New
Barium Nitrate	35	25
Ammonium Perchlorate (Class 7)	20	25
Cellulose Acetate	12.5	15
Triacetin	12.5	15
Magnesium	10 (234)	20 (350µ)
Ammonium Chloride	10	

Percent by Weight

The red flare composition carried over from the previous program burned 15 seconds short of the requirements. Therefore, a modification was made to the formulation which brought the time up to the required 90 seconds. The ammonium perchlorate content was reduced 5 percent and the magnesium content was increased 5 percent. In addition, the magnesium particle size was increased from 22 microns to 350 microns. Both the old and the new formulations are listed below for comparison.

	Percent	by Weight
Components	<u>O1d</u>	New
Strontium Nitrate	40	40
Ammonium Perchlorate (Class 3)	30	25
Magnesium	5(22/4)	10(350%)
Cellulose Acetate	12.5	12.5
T riacetin	12.5	12.5

The use of the new formulation initiated in Phase II of this program and performed satisfactorily throughout the balance of the program.

No changes were made to the yellow flare mix during this program. For reference, the yellow flare mix formulation is as follows:

Components	Percent by Weight
Sodium Nitrate (Class 2)	45
Ammonium Perchlorate (Class 3)	15
Magnesium (22/4)	15
Cellulose Acetate	12.5
Triacetin	12.5

This formulation performed satisfactorily throughout the program.

## TEST RESULTS

#### 1. BASELINE TESTS

To check out the green baseline composition and the intermediate igniter mix between the ignition charge and the main charge, two static tests were conducted. The test results shown in Appendix A verified the results reported in the previous feasibility program.

### 2. GREEN FLARE ADDITIVE TESTS

The color additives for the green flare were investigated in three separate series. The first series screened all candidate additives by simply adding two additives to the base formulation and replacing the binder. The second test series screened the best additives from series 1 by replacing one component of the basic formulation with the additive. Several additives and components were evaluated in test series 3 by multiple substitution into the basic formulation. Evaluation was carried out by static daytime tests, static night tests for range determination and daytime flight tests.

# a. Test Series 1 - Additives Screening

# (1) Objective

The objective of this series was to screen additives which were incorporated in the basic formulation to determine the effect on color quality.

## (2) Test Method

The additives were incorporated into the basic formulation, replacing binder - 10 percent additive for 10 percent binder. Twenty-six additives, listed in Table I, were tested. Color and burn time were recorded. The most promising additives were then tested in the basic formulation by adding 10 percent to the total formulation. All candles were tested in water without a ballute. The basic formulation is as follows:

# TABLE'I - ADDITIVES

Cupric Nitrate

Cupric Chromate

Cuprous Chloride

Cupric Acetate

Cuprous Oxide

Copper

Chromium

Chromic Chloride

Ammonium Dichromate

Chromic Acetate

Boric Acid

Tetrachloro-P-Benzaquinone

Nickel Acetate

Nickel Nitrate

Nickel

Nickel Chloride

Titanium

Zinc

Zinc Chloride

Borium Chromate

Boron

Zirconium

Picric Acid

Potassium Permanganate

Tin

Bronze

Component	Percent by Weight
Barium Nitrate	35.0
Ammonium Perchlorate 400 Micron	20.0
Ammonium Chloride	10.0
Magnesium, Mesh $\frac{200}{325}$	10.0
Cellulose Acetate	12.5
Triacetin	12.5

### (3) Results

From this series, the following compounds were selected for further investigation in test series 2:

Chromic Chloride, Chromic Acetate, Chromium Metal, Ammonium Dichromate, Titanium, Zirconium Nickel, Nickel Acetate and Nickel Chloride.

A shoot off of the first four additives which were the most effective was conducted. The most effective additive was chromic chloride. However, the effect was not as great as expected. All raw date is shown in Appendix B.

## (4) General Observations

This series indicates some color improvement can be obtained with additives. Generally, the additives which improve color quality also increase burn rate. Chromic chloride, when damp, reacts with magnesium; therefore, the magnesium should be coated (chromalized) to prevent this reaction. Nickel nitrate was found to be incompatible in the basic formulation.

# b. Test Series 2 - Additives Substituted for One Component

# (1) Objective

The objective was to further investigate the color improvement properties of the additives selected in test series 1.

## (2) Test Method

The additive replaced one component, totally or partially, that most closely related to the additive; i.e., chromic chloride replaced ammonium chloride, chromium replacing magnesium, etc. The effect of each additive on color and burn time was compared to the control baseline formulation.

## (3) Results

The results of test series 2 indicated that some color improvement may be obtained from certain additives. The best additives are listed as follows:

Chromic Chloride Chromic Acetate Chrome Metal

Intensity of the flare improved color to some extent, at the expense of shorter burn time.

Removal of the phenolic liner insulator tended to improve the color by reducing the amount of yellow seen in the plume with approximately 10 to 15 percent loss of burn time when tested in water. Raw data on this test series are shown in Appendix C.

# c. 3500-Meter Night Visibility Tests

# (1) Objective

The two major objectives of this test group were to determine if chromic chloride additive gives a more recognizable color than the control baseline formulation, and to determine if a more intense flare is more recognizable than the basic formulation.

### (2) Test Method

Each test formulation was compared directly to the basic formulation. Each unit was tested without a ballute in water. The observation area was 3500 meters distant and 300 meters above the test sight. Weather was clear with a slight haze; visibility was greater than 10 miles.

## (3) Results

Thirty-five hundred (3500) meter night visibility tests showed chromic chloride additive to improve the color when compared to the control. A deep rich "stop light" green was observed. The intensity was less than that of the control formulation, and neither one was really adequate.

The more intense burning formulations such as the polyvinyl chlorides were definitely recognizable as green. The color quality was about equal to the control units, but more intense. Boric acid additive improved the color to some extent, while reducing burn rate significantly. However, color improvement from boric acid was not as great as that from chromic chloride.

These intense formulations were used for intensity only. They are not suitable for the 40MM floating flare because of high flame temperatures, excessive slagging properties and drastic reductions of burn time. The data from the night visibility test are presented in Appendix D.

# d. Test Series 3 - Multiple Substitution

# (1) Objective

The objective of this series was to determine the effects multiple substitution of components and additives on the basic formulation's color quality and burn time.

### (2) Test Method

Additives including boron, chromic chloride, polyvinyl chloride, potassium perchlorate, and teflon were substituted for various ingredients in the basic formulations. In addition, the granulation size of both the magnesium and ammonium perchlorate was varied and the effects noted. The burn time was recorded by a stop watch and the intensity by a photocell.

### (3) Results

The primary results of this test series is shown on the graphs of Figure 3 through 6 and the raw test data is presented in Appendix E. Figure 3 is a plot showing the effect of magnesium and ammonium perchlorate particle sizes on intensity. The optimum particle size for ammonium perchlorate is 400 microns, while the optimum size for magnesium appears to be above 400 microns. This is one reason why 400 micron ammonium perchlorate and 350 microns magnesium is being used on the new green formulation.

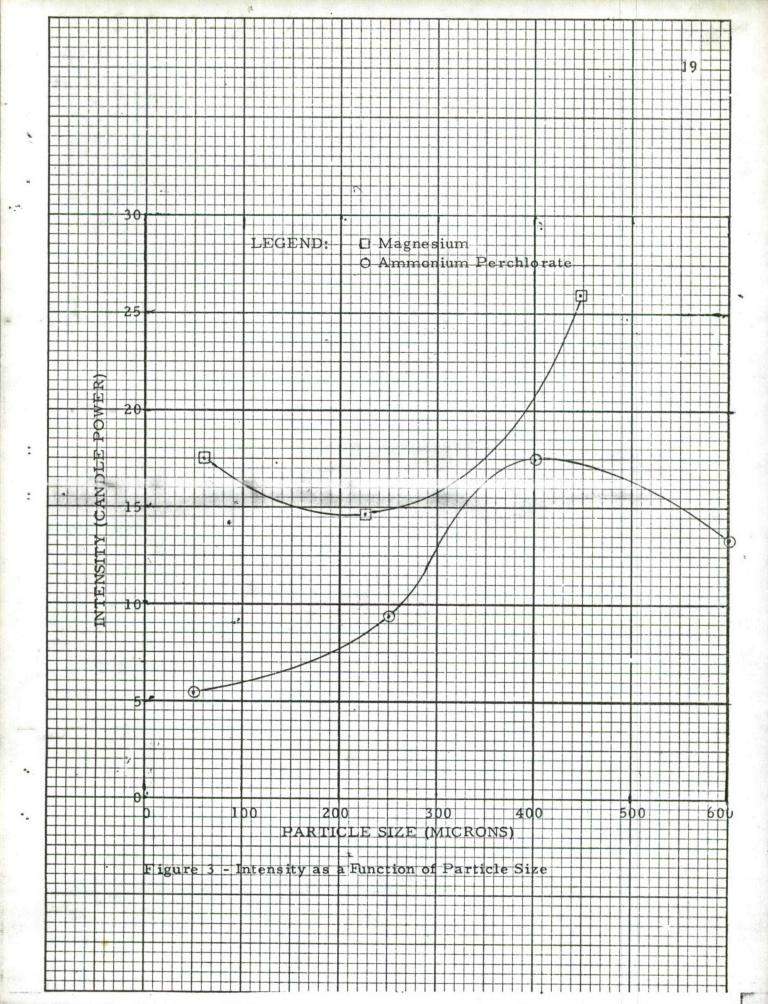
Figure 4 shows the effect of magnesium percent on the intensity measurement. The family of curves was generated by substituting magnesium for various components in the basic formulation. Note that light intensity is very sensitive to the magnesium content and that the substitution of granulation 16 (22 microns) magnesium for ammonium chloride gives the greatest intensity.

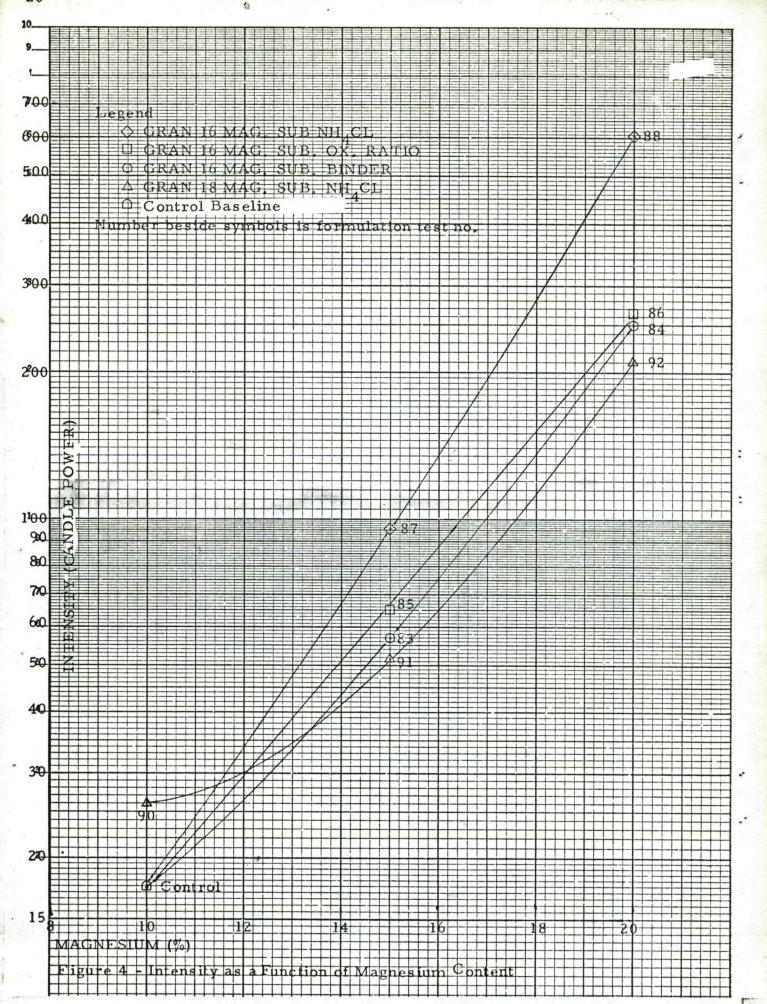
The above is the reason why ammonium chloride was dropped from the formulation in favor of more magnesium.

Granulation 16 magnesium had to be changed to granulation 18 in order to maintain the proper burn time. This will be discussed later in the report.

The effect on intensity and burn time of varying the amount of barium nitrate is shown in Figure 5. The effect is not as great as the variations in magnesium content.

Figure 6 shows the influence of magnesium on burn time. Note that a two percent increase in magnesium reduces the burn time approximately ten seconds. Another significant fact obtained from Figure 6 is that approximately a 30-second burn time increase was obtained by using 350 micron size magnesium instead of the 22 micron size of the control formulation. Because of the short duration problem mentioned above, 350 micron magnesium was finally selected.





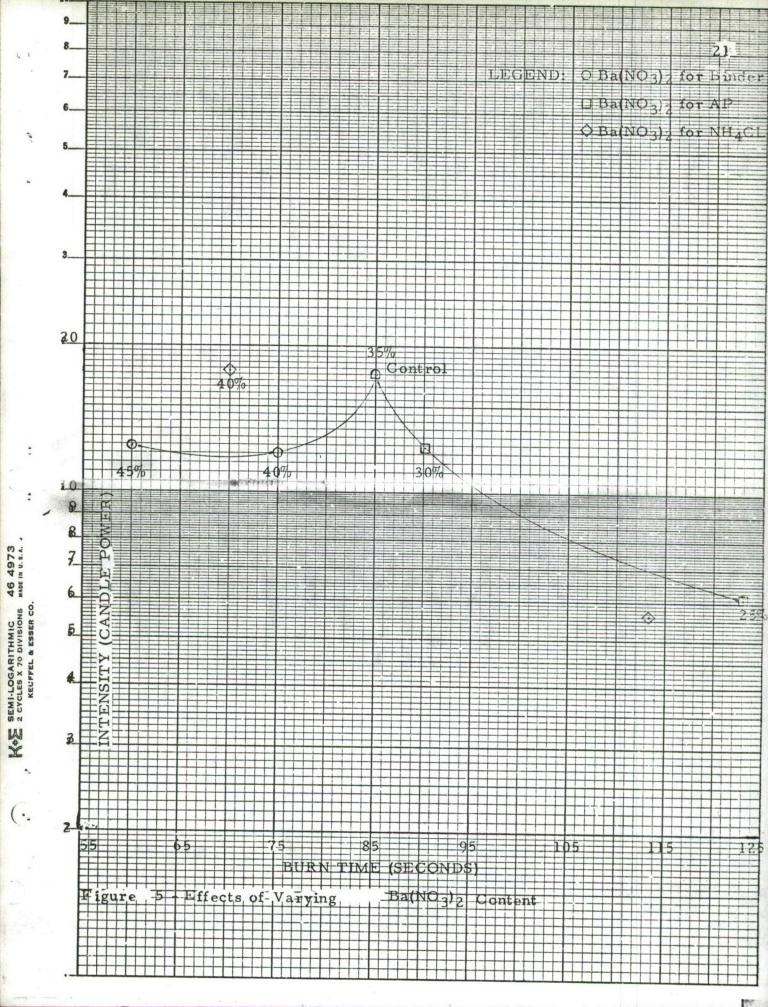


Figure 6 - Burn' Time as a Function of Magnesium' Content

Pressing pressure was evaluated in test series 119 through 122. By increasing the quantity of mix from 60 grams to 70 grams while maintaining the same charge volume, the burn time increased approximately 5 to 7 seconds. Therefore, the compaction pressure is not considered critical.

The use of a chrome plated chimney to prevent iron off of the chimney from entering the gas stream was evaluated in Test 149. The advantage of the plating was not significant.

In summary, the formulation that gave the best combination of intensity and burn time uses less barium nitrate, more ammonium perchlorate, magnesium, and binder than the baseline mix. This formulation also has no ammonium chloride coolant. Both the baseline formulation and the new formulation are listed below for comparison.

	Percent by Weight						
	Baseline	New					
Barium Nitrate	35.0	25.0					
Ammonium Perchlorate							
(400 1)	20.0	25.0					
Magnesium	10.0 (224)	20.0 (350%)					
Cellulose Acetate	12.5	15.0					
Triacetin	12.5	15.0					
Ammonium Chloride	10.0	0					

# 3. PHASE I DEVELOPMENT AND QUALIFICATION TESTS

The projectile tumbling problem, which had occurred randomly in previous flight tests, was solved by switching to a relatively new gun barrel. As shown by the data sheets in Appendix F, tumbling did not occur after the newer gun barrel was used.

Sinking rarely occurred after increased stitching on the ballute was used. Thereafter, sinking usually could be attributed to a ballute that had been pinched or cut during assembly.

The next test series, 209 through 214, showed an ignition problem in transferring from the delay to the first fire layer. This was the first tests of the second lot of delays and therefore the delays were suspect. In fact, in test 211 the unit was recovered and the delay had expelled a portion of the tungsten composition into the projectile body. X-ray examination of the delays showed the presence of delay first fire between the two increments of tungsten composition. The delay vendor was contacted to correct the problem.

In order to circumvent the delay problem and continue testing, five green units were fabricated with one gram of FFG black powder in the first fire and five standard green units were fabricated at the same time as control rounds. However, the black powder did not aid the first fire ignition and ogive ejection because of the delay problem. Two out of the five rounds containing the black powder were duds. The test results and data are shown in Appendix F. Serial numbered rounds 216, 218, 220, 222 and 224 had the black powder additive in the first fire. The other five units, 215, 217, 219, 221, and 223 were built like the previous units without any black powder in the first fire. One dud was experienced from this group.

Ten green units were fabricated to evaluate the new, carefully made delays. The flare ingredients were dried overnight at 150°F. The ten rounds were assemblied and flight tested. All ten units functioned satisfactorily proving the new delay pressing procedure. The data on the flight tests of these ten rounds are shown in Appendix F (S/N 225 through 234).

Ten additional green units were fabricated and tested to checkout a new batch of 120 delays. These units (S/N 235 through S/N 244) also were used to verify the assembly technique of a new technician.

As can be seen from the data in Appendix F, the delays functioned normally with time ranging from 5 to 5.8 seconds. However, the technician inadvertantly left out the plastic orifice in the chimney. The first four units were fired into water and tumbling was observed after flare ejection. Normally when this occurs the ballute has a hole or a ripped seam. To determine the specific nature of the failure, unit 239 was fired onto land and recovered. The stitched seam on the ballute's outer circumference was broken. The remaining five units were disassembled and rebuilt with the plastic orifice. All of these five rounds functioned normally. Although the reason why the lack of an orifice causes ballute seam damage was not fully understood the effect was extreme.

Green units 245 to 254 were fabricated and tested to check out a new batch of first fire and to evaluate the effect of a cut ballute on flotation performance. From the data shown in Appendix F, only 6 out of 10 functioned satisfactory. However the units with the cut ballutes functioned adequately. The ejection of the flare from the projectile body was sluggish which is a problem associated with the combined effects of delay venting, first fire combustion, chimney orifice insert and ogive joint. In order to aid in determining the cause of the failure, five units from the same batch were disassembled and inspected. These units, 255 to 259 were found to have been assembled correctly and were reassembled with different ogives to see if ogive ejection was the source of the problem. Ogives on units 255 and 256 were replaced with white ogives, a design which was used on the previous program. 257 and 258 were repacked with new ogives of the current configuration. 259 was repacked with the original ogive. As shown in the appendix only one unit failed to function properly. Unit 257 which had been repacked with a new ogive sank. Even though this test series showed that the ogive could be a contributor in the sinking problem it is one of the most difficult elements in the chain to modify. Lack of quantative data on slot configuration, glass content and lip design make the ogive release force the most difficult to evaluate analytically. Therefore, it was decided that a review of the first fire should be made. Previous batches of first fire were made with the ingredients unscreened. The first fire batch for units 245 to 259 was made by screening the ingredients in an attempt to get more uniform mixture. Ten green units were made by the earlier process and flight tested. As shown by the data sheets for units 260 to 269 all units functioned normally. This successful test series tended to prove that the method of first fire processing was the cause of the previous sinking problems.

Units 270 to 301 were fabricated and tested for the qualification of the green flare batches. The test results were not perfect but satisfactory.

A special static test series was conducted with green flare units 302 to 307. Zinc, cadium and nickel plated chimneys were used to see if color quality would be affected. No effect was noted.

Because of random ballute seam failures, the thread size was increased from a number 50 to a number 40 for the subsequent units. Units 308 to 331 were qualification tests for all three colors. Because two out of five red units on the last batch failed, the batch was rejected. It was observed that the red units tended to flame out in flight tests. To observe this phenomenon more closely, two units from the same defective batch were burned in the laboratory. Units 332 and 333 functioned normally with the flame standing off from the chimney. However, because of the poor flight tests, the batch was rejected. The new batch was tested with units 334 to 337. Since only one unit sank, the batch was accepted. It was speculated that a hole burned in the ballute may have caused the unstable descent and sinking of that one unit.

Two units, 338 and 339, were made in the laboratory to determine if a longer-burning-duration flare could be achieved with a modified red formulation. The magnesium particle size and quantity was increased from 22 microns and 5 percent to 350 microns and 10 percent. The ammonium perchlorate content was reduced from 30 percent to 25 percent. The last unit burned 91 seconds which is a substantial improvement over what was previously achieved. Both the old and the new formulation are listed below for comparison.

	Tercent by	TV CIGITO
Components	<u>Old</u>	New
Strontium Nitrate	40	40
Ammonium Perchlorate (50µ)	30	25
Magnesium	(سر22) 5	10 (350m)
Cellulose Acetate	12.5	12.5
Triacetin	12.5	12.5

# 4. PHASE II DEVELOPMENT AND QUALIFICATION TESTS

Green units 340 to 350 were fabricated and tested for Phase II qualification. However, as shown in Appendix G, four units had trouble in ejecting the slag buildup in the chimney. During the course of the subsequent investigation an attempt was made to isolate the source of the slag buildup. One theory was the char from the plastic chimney insert acted as a catalyst causing the solid exhaust products to condense out on the inside of the chimney. Therefore, to check out this theory, three

units (S/N 351, 352 and 353) were static tested with the plastic insert the full length of the chimney. This was expected to cause an increase in the slag accumulation. However, the opposite occurred, there was no slagging of any kind and all three units burned smoothly. Flight tests conducted on green units numbers 354 to 363 also verified that the longer insert eliminates the slag buildup in the chimney. One reason that the longer insert may have prevented slagging is the hot char layer that the insert creates prevents condensation of the solid exhaust products. In addition, the char surface may prevent a strong bond of the solid products to the chimney.

Units 364 to 373 were flight tests for red color qualification. All units performed very satisfactory. All ten red units also employed the longer insert in the chimney and the new formulation.

The qualification units for the yellow (374 to 381) also performed quite satisfactory with the full length plastic chimney insert. Unit 382 was an extra red unit that was tested with the yellow rounds and it too functioned normally.

## 5. PHASE III DEVELOPMENT AND QUALIFICATION TESTS

Because of doubts about the exact specification for the ammonium perchlorate used in two of the colors, a sieve analysis was performed on three samples. This granulation analysis was conducted in accordance with method 201.1 of MIL-STD-1234 and the results are given below.

		% Passi	ng thru	Sieve	% Ret	ained o	n Sieve
			Sample	:		Sampl	le
U.S. Sieve	Microns	1	2	3	1	2	3
100	149	100	100	100	0	0	0
140	105	96	95	95	4	5	5
200	74	74	72	70	26	28	30
325	44	69	71	69	31	29	31

From the above analysis it appears that the ammonium perchlorate sometimes referred to as 50 micron size should be specified as Grade B, class 3 of MIL-A-192.

Phase III qualification started with eighteen green rounds (383 to 400), however as shown by the test data in Appendix H only eleven functioned satisfactory. Seven rounds failed to eject at delay burnout and two of these rounds vented through the delay causing the rounds to go propulsive. From past experience it was immediately concluded that these failures were caused by the slowness of the ignition mix. This problem had occurred before and was solved by very careful control of the manufacturing procedure. However, because of the reoccurring ignition problem it was decided to reduce the binder content. The ignition charge

has two different binders, lupersol DDM/polyester and teflon. In addition. the binder quantity is quite high, over twenty three percent. Therefore, five rounds (401 to 405) were made and tested using an ignition mix with twenty five percent less teflon. Two rounds functioned satisfactory, one ejected and burned under water and two rounds went propulsive. Units 406 to 408 were fabricated and tested to determine the effect of no teflon in the ignition mix. All three of these rounds performed normally except that all three sank immediately after burnout. It was concluded that the greater pressurization rate of the ignition mix without teflon must have ruptured the ballutes. If this was the case then premature sinking could occur. Therefore, five rounds (409 to 413) were manufactured with seventy five percent less teflon in the ignition charge and test fired. As shown in Appendix H all but one round experienced good ejection and flotation. One unit had a delay failure which could not be assigned as an ignition failure. To confirm the success of the above tests and to complete qualification of the green flares, Units 414 to 426 were fabricated and tested with seventy five percent less teflon in the ignition mix. All but one round performed normally. The one failure was believed to have been caused by a delay failure since no spit was seen from the delay at the proper ejection time.

Units 427 to 446 were flight tests for red color qualification. All twenty units performed very satisfactory.

Units 447 to 461 were flight tests for yellow color qualification. All of these rounds functioned completely as shown in Appendix H.

# APPENDIX A

BASELINE GREEN FLARE DATA

DATA SHEET

FLOATING FLARE	1
40MM FI.C	
-	BAS

A				X									
Weight (gms)  Date of the street of the stre		Configuration and/or Remarks				gram first grams	ase line ver	o. k.					
Mumber   Test   Date								Ŋ					
Mumber  Test  Test  Date  Ba(NO 3) 2 Nitrate  The secondary of the secondary  Composition  Other of the secondary  Additives  Composition  Other of the secondary  Composition  Other of the secondary  Additives  Composition  Other of the secondary  Color of the secondary  Col	-			-	-	-		-	-	-	-	-	 
Weight (gms)  25  26  27  27  27  28  29  20  20  20  20  20  20  20  20  20		Ballute			2 337	L L		g+ 1					
Mumber  Test  Date  Date						_		_			-		
Mumber Test Test Date Date  25							_	1					
Mumber Test Test Date  Ba(NO) 2 Nitrate Date Date Date Date Date Date Date D					el verifica	po	7.44	po					
Mumber Test Test Date  Ba(NO) 2 Nitrate Date Date Date Date Date Date Date D						go		go					
Test   Date													
Mumber Test Date Date  35													
Weight (gms)  Aumber  Aumber  Aumber  Aumber  August August August (gms)						7		6					
10   10   10   10   10   10   10   10	-	Burn Time				7		2					
Aumber  Test Date  Date  Date  Date  Cran. IcMagnesium  Cran. IcMagnesium  Cran. IcMagnesium  Cran. IcMagnesium  Cran. IcMagnesium  Conposition  Additives  Composition  Composition  Weight (gms)	(s					2		2					
Mumber Test Date Date  Ba(NO) 2 Nitrate  Cran. 16 Magnesium Composition  20 20 21 22 24 25 26 26 26 26 26 26 27 28 29 20 20 20 20 20 20 20 20 20 20 20 20 20						1/		1/					
Test Date  3. 3. 3. Ba(NO.) 2 Nitrate  3. 3. Cran. 16 Magnesium  3. CA 50 Binder  2. CA 50 Binder  3. CA 50 Binder  3. CA 50 Binder  3. CA 50 Binder  4. CL Coolants  5. Coolants  6. Coolants  7. Coolants  7. Coolants  8. Coolants  9. Cher						0		0					
Mumber  Test Test Date  35	U					9		9					
Test Test Date  10 Cran. 16Magnesium Contaire  25 CA 50 Trade Condary CA 50 AP Secondary Canal													
1 sest A A A B Date	r r	Other											
1sert A A A A B Date	sitic	Coolants	כד	<sup>†</sup> HN		10		10					
1s9T 4 4 5 Date	00	TazibixO						_					
1s9T 4 4 5 Date	m					20		20					
1sert A A A A B Date	t Co		09	CA		25		25					
1s9T 4 4 5 Date	rcen	muisəngsM	-										
1 1 4 4 7 7 7 1 9 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Pe			D <sub>a</sub> (IV								-	-
19quin   Namber			, 0	14/ 0									150
19quin N						4/1	2 2 24	1/1		- All-1	7.	, b,	
Serial   Serial						A	6.8	A.					19

# APPENDIX B

TEST SERIES 1 - GREEN FLARE COMPOSITION DATA

APPENDIX B - 40MM FLOATING FLARE

DATA SHEET

Test Series 1 - Additives Replacing Binder

		ž.										en.	
	Configuration and/or Remarks	1 gram 100% first fire 2 grams 50% first fire 50% flare mix	Blue-white - no green.	1		Blue-white - no green.			Blue-white - no green.			Blue-white - very slight tint of green.	,
ı	Static or Flight Test		v.			ω,			S			S	
	Intensity Candlepowe	1											
	Water or Land Test		M			A			M			M	
	Color Quality		Poor			Poor			Роог			Poor	
	Burn Rate (in, /sec)		14			14			14			- 14	
	Burn Time (seconds)		55	e .		99	nate		39	ride		55	e t
(s	First Fire Weight (gms)		1/2	Cupric Nitrate		1/2	Carbonate		1/2	Chlbrid		1/2	Cupric Acetate
	Composition (smg)		09	ric I						Cuprous			ric A
	Other Additives		10	Cup		10	Cupric		10	Cup		10	Cup
sition	Coolants	NH3 HCL	10				100						
Percent Composition	Secondary Oxidizer	0.10	20		V.			,					
	Binder	CA	15										
	muisəngsM	200 325	10										
	Nitrate	Ва	35								3 8		
	Test Date		5/13			21/9			5/12			5/12	
	Serial TadmuN		1			2			3		40.4	4	

40MM FLOATING FLARE

Test Series 1 - Additives Replacing Binder

		E		T	I	T		T			I	T
	Configuration and/or Remarks	1 gram 100% first fire 2 grams 50% first fire 50% flare mix	Blue-white - no green,			Blue-white - very slight tint of green.	×		Intense green, even color in plume.		Intense green.	
	Static or Flight Test		S			S			w		S	
J	Candlepowe								$\vdash$			
	Land Test Intensity				-						-	-
	Water or		Μ.			M			M		M	
%	Color Quality		Poor			P001			Good		Good	
	(in. /sec)				,			-				
	(seconds)			-		-		-			-	de
	Burn Time	y 1	42	de		52	1		51		32	Chloride
(5	First Fire Weight (gms		1/2	Oxide		1/2	Metal		1/2	Chrom Meta	1/2	Ch
	Weight (gms		-	ons					09	H H		nie
U	Additives Composition			Cuprous		-	Copper	-	1	TOI	 -	Chromic
d	Other	i i	10	Cu		10	S		10	Ch	10	Ch
itio	Coolants	$^{ m NH}_3$										
bos	TazibixO										<del>                                     </del>	
om	Secondary											_
of C	Binder	CA								•		
Percent Composition	muisəngsM	200 325										
Pe	Nitrate			- 2						v		
	Date	-	7.5		- 2	5/72			5/72		5/72	
	Test		5/12			5/			5/		2	
	Serial TodmuN		2			9			1		∞	

Binder
Replacing
- Additives
_
Test Series

			×			,								
		Configuration and/or Remarks	gram 100% first fire grams 50% first fire 50% flare mix	reen.			Intense green.			Did not burn,			Color equal to control,	
ŀ		Flight Test	1 2	S			S			S			S	
	J	Candlepowe Static or					-		-				-	ļ
		Intensity												
		Water or Land Test		W			×			≽			×	a)
		Quality		od			0						ir	chloro-P-Benzoquinane
-		Color		Good	e		G000						Fair	qui
		Burn Rate (in, \sec)			ma				As .					nzo
-	,	(seconds)		-	hro			te		1			**	-B
	(s	mg) Jugis W	_, .,	09 3	Dic		09	Acetate		-		-	84	1
	(5	First Fire		1/2	ur		1/2				id			oro
•		Weight (gm			oni			nic			Acid			chl
-	u	Additives Composition			Ammonium Dichromate	-	-	Chromic			Boric			Tetra
	u	Other	m 1	10	A <sub>1</sub>		10	Ü		10	B		10	H
	itic	Coolants	$\frac{\mathrm{NH}_3}{\mathrm{HCL}}$											
	npos	Secondary Oxidizer	412											
	Cor	T sbni d	-									1		
	Percent Composition	muisəngsM					+							
	Pel	Nitrate	ø					-		-				
		Test Date	В	772			5/72			5/72			5/72	
		Serial		6			10 5			11			12	
		61435				•				1			1	

40MM FLOATING FLARE

Test Series 1 - Additives Replacing Binder

			, >								· .		3
		Configuration and/or Remarks	1 gram 100% first fire 50% flare mix	ightly better than con rmulation.			Nickel nitrate is incompatible with these components.		Slightly better than control formulation.			Better than standard - not as good as Chrom and Chrom Salts.	
		Flight Test		S			S		 S	-		Sa	
ŀ	J	Candle power		+		-	$\vdash$					-	
-		Intensity										1	
		Water or Land Test		A			$\geqslant$		8			M	
1		Quality		Fair			-		 00			00	
1		(in, \sec)		FIG					 Fair			Good	
		Burn Rate				- 45		4					
1		(seconds)		1			,			0)			
1	(5	Weight (gms amiT nrud		2 61	ate		-	atte	57	Chloride	-	51	
1		First Fire	1	1/2	Acetate		1/2	Nickel Nitrate	1/2	hlo		1/2	
		Weight (gms			1 A			Z					um
-		Additives Composition	_		Nickel			che	 -	Nickel			Titani
	п	Other		10	N.		10	Z i	10	Ni		10	T it
	itio	Coolants	NH3 HCL										
	Composition	Secondary Oxidizer	400 I										
	Cor												
	Percent				****			-					
	Pe	Nitrate	a 3 2					-		$\dashv$			
-		Date	<u>B</u>	7	-		7	-	 2		-	2	
L		Test		5/72			5/72		5/72			5/72	
		Serial redmuN		13			14		15			16	
L		[ciao2					-	- 1	7	1		7	

40MM FLOATING FLARE

Test Series 1 - Additives Replacing Binder

-		×									 	
	Configuration and/or Remarks	1 gram 100% first fire 50% flare mix grams 50% first fire 50% flare mix	Better than standard - not as good as Chrom & Chrom Salts.			Better than standard - not as good as Chrom & Chrom Salts.			Slightly better than control,		Green-white - Very hot.	
-	Flight Test								01			
	Static or		S			S			S		N	
J	Candlepowe											
1	Intensity											
	Land Test		W			M			M		M	
	Water or											
	Quality		Good			Good			Fair		Fair	
-	Color		G			D			E C		F C	
1	(in. /sec)		100 in a 40	Parties and	Made a sur							
	Burn Rate		The states					-		-		
	(seconds)		2			-			09	at	27	
1-76	Burn Time		19			61	0)			Chromate	 	
(5	Weight (gms	1/2	1/2	-1		1/2	Chloride		1/2	hr	1/2	
- (5	Weight (gms First Fire			Metal		-	- 2		-			
1 '	Somposition O			M			บี			mm	09	g
-	Additives	15		nc		$\vdash$	2		-	arii		Boro
1	Other		10	Zinc		10	Zinc		10	Ba	10	Bo
ition	Coolants	$^{ m NH}_{ m HCL}$										
300	TazibixO	010										
m	Secondary	$\frac{AP}{400}$										
or to	T əbni a	CA										
Percent Composition	muisəngsM	<u>200</u>				-					5	
P.	N itrate	Ba					-					
	Test Date		5/72		9	5/72		7	5/72		5/72	
	Serial 19dmuN		17			18			19		20	

DATA SHEET

Test Series 1 - Additives Replacing Binder

-		×	-		1								
	Configuration and/or Remarks	1 gram 100% first fire 2 grams 50% first fire 50% flare mix	ve,	Good color, better than standard, equal to color of chrom acetate and		Best color of shoot off, Deepest rich green of all 6 tests.			Good color, better than standard, equal to color of chrom metal and	ammonium dichromate.		Good color, better than standard, equal to color of chrom metal and	chrom acetate.
	Flight Test		Idit		-					-8			0
	Static or			S		ß			S			S	
I.	Candlepowe		color improvement by	1									
-	Intensity		nt nt										
1	Water or Land Test		me			≥ .		*	>			*	
	Quality		Ve.	0			<u> </u>	-			-		
	Color		oro	Good		Good	i cert		Good			Good	
	(in. /sec)		II II	1-0-		F					<u> </u>	0	nonium Dichromate
	Burn Rate		r i										m.
	(seconds)		olo	-		Ι.	ide			e			hr
	Burn Time	_	ΰ			'	Chløride		1	Acetate		1	ic
(8	weight (gms	1/2	best	1/2		1/2	hl		1/2	ce		1/2	l L
(5	Weight (gms First Fire		e p	-		-			1			1,	T III
1	Composition		mine	09	om	09	omic		09	omic		09	onj
	Additives		- 1		ri		ro					9	-
_	Other		deter	10	Chr	10	Chr		10	Chr		10	Amn
sitio	Coolants	$^{ m NH_3}_{ m HCL}$	to d										
pod	Oxidizer	10	were										
Com	Secondary	-											
ent	Binder		tests										
Percent Composition		33	9 gu										
	N itrate	Ва	following										
-	Date		1	/72		/72			/72			22	
-	TesT		4	2/		2/			/9			5/72	
	Number		The	21		22			23			24	
	Serial			,,,		14			2			2	

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		Configuration and/or Remarks	1 gram 100% first fire 2 grams 50% first fire 50% flare mix	Better than standard - color quality almost equal to chrom salts.		Standard formulation.		Good color - produced the most light to date; however, a lot of	white in green,					
		Static or Flight Test		S		S		w						
+	J	Candlepowe								le .				
		Intensity					N							
		Land Test	10.	W		W		W						
_		Wateror												
		Vality Q		Good	`	Fair		Good						
-		Color		Ü		দ		Ü				-		
	HAR	(in, \sec)			750									
-		Burn Rate					-	_		-	-	-		-
	`	Burn Time (seconds)		- 1		1								
-	(s	Weight (gm		2		-2		2		-	-	-	+	
	(5	First Fire		1/2		1/2		1/2	д				1	
-	(s	Weight (gm							oniam	261		-	<del>                                     </del>	
	·u	Composition		9		09		09						
-		Additives						0	Ziac					
	_	Other		0				10	Z					
	Percent Composition	Coolants	$^{ m NH}_{ m HCL}$	11.1		10		10						
1	osi	19zibixO	ZE				-	-	-	-		-	+-	1
1	du	Secondary Oxidizer	4100 1000 1000 1000 1000 1000 1000 1000	22.		20		20						
	on		1 1	7		(4			-		<b> </b>	1	1	
	it C	Binder	CA	16.7 22.1		25		15						
	cen	Magnesium		11,1		10		10						
	er		3 2	11		-		-		-	-	-	-	-
	Д.	Nitrate	Ba	39		35	iv e	35						
-		Date	-			1	-		_	<u> </u>	-	1	1	1
		Test		5/72		5/72	-	5/72						
1		Number											1	
		Serial	1	25		56		27		1				

40MM FLOATING FLARE

DATA SHEET

Test Series 1 - Replacing all Components 10% with Additive

	×	50% flare mix				green-yellow		w at Darkest	32.			
	Configuration and/or Remarks	1 gram 100% first fire 2 grams 50% first fire	or. Lot of lig			Good color. Faded to gree at end.		Good color. Turned yellow times (non-homogenious).	(richest) green of 27B and		Poor yellow-green color.	
	Static or Flight Test		N			S		S			S	
J	Candlepowe				1	$\vdash$			-			
	Intensity											
	Land Test		M			8		8			×	1
	Wateror					1 1					1	-
	Quality Quality		Good			Good		Good			Fair	
	(in. /sec)		<u>D</u>	-	-	D F	-	 Ü	-	-	HID	ate
	Burn Rate	2	-									m
	(spuoses)						Acetate		de			Dichromate.
	Burn Time		40			55	cet	62	ori		75	ic
( 5	Weight (gms						A		Chlorid			
- (	Weight (gms First Fire			_	_		- 5	 			-	in
	Composition Waish (ams	9		om			omium		omic			nonium
-	Additives		.0	910					ıro	-		n
d	Other		10%	Chr		10	Chr	10	Chr		10	Amı
Composition	Coolants	NH3 HCL	6									
odwo	Secondary	AP 400	18									
	Binder	50	22.5									
Percent	muisəngsM	200 325	6	-								
д.	Nitrate	Ва	31, 5									
	Date		-72			-72		-72			-72	
1	Test	1	2			77	- 1	 77			5	
	Serial TedmuN		27B		-	28		29			30	

40MM FI OATING FLARE

% with Additive	
10%	
ents	
por	
1 Componen	-
a11	1
lacing	-
ep	t
4	1
3	
Serie	
est	
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	. 1.	N K			T							T'he	
	Configuration and/or Remarks	1 gram 100% first fire 2 grams 50% first fire 50% flare m	Very hot, melted chimney, lot of sparks. Large amount of light.		,	Good color, best toweard end of burn. Lot of sparks, hot.			Green, some yellow, Faded			This improved the color some. The	ì
	Flight Test		S			S			S		-	ß	
I	Candlepowe Static or												
-	Intensity												
	Land Test		W			W			M			8	
	Water or											1 1	
	Yality		Good			Good			Good Fiar			Good	
	(in.\sec)		Ŋ			O			O H	rte			
	Burn Rate		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1							nga		40	
	(seconds)		~			_				ermangate			
-	Burn Time	. 1	43			53			09	e I		09	
(s	Weight (gm	1/2		d						n P			77
(8	Weight (gm: First Fire			nium			멸		-	sium		-	Acid
	oitisoqmo S	9		iuos			T itanium	-		ssi			A C
	Additives			ir			tar			Potas			Piric
d	Other		10	Zir		10	Ti		10	Pc		10	Pi
Percent Composition	Coolants	NH 3 HCL											
oduu	Secondary Oxidizer	0											
ıt Co	Binder												
rcer	muisəngsM	200 325											
P(	N it rate		,				,						-
	T est Date		5/72			5/72			5/72			5/72	
	Serial Number		31			32			33			34	

40MM FLOATING FLARE

Test Series 1 - Replacing all Components 10% with Additive

			-		_	1000	 		_		_	
	Configuration and/or Remarks	1 gram 100% first fire 2 grams 50% first fire 50% flare mix	ore transpare				Blue-white - slight green tint,			Yellow-green.		
	Static or Plight Test		S		w	I)	S			S		
	Candlepower					(IN %	-			-		-
	Lntensity					. 7%						
	Water or Land Test		≱		M	ZN	M			W		
-	Yality		힌니		po	2%	8			H .		
	Color		good		good	SN, 2%.	poor			poor		
	(in, /sec)		75									
-	(seconds)			_		8%						
	Burn Time		09		75	CU,				29		
	(gmg) thgis W											
_	First Fire					%68)						
	Composition (gms)	09				Ze		er			1	
-	Additives					ronze	 . 0	Copper			Nickel	-
1.	Jenio				10%	Bı	10%	ပိ		10	Nii	
17:	Coolants	NH 3 HCL	10		6		6			6		
	Secondary Oxidizer Coolants	네이	20		18		18			18		
1	Binder		25		22,5		22.6			22.5		
4004	muisəngsM	<u>200</u>	10		6		6			6		
р	Nitrate .	Ba	35		31,5		31, 5			31, 5		
	Date		/72		5/72		/72			5/72		
-	Number Test		5				 5					-
	Serial		35		36		37			38		

Test Series 1 - Replacing all Components 10% with Additive

		1		T	T	T		T	T	T	T	T	T
	Configuration and/or Remarks	1 gram 100% first fire	3			Shoot off between 40 and 41 - slightly better than control.	The state of the s		Control formulation,				
	static or Tight Test	1	S			S			.v				
1	Candlepower		-	-				-	_	-	-	-	-
	Intensity												
1	Water or Land Test		≱			≱			≽				
	Yality		00	-	<del>                                     </del>	0			70		-		
	Color		good			good			good				
	Burn Rate (in, /sec)												
-	(seconds)						-					_	
,	Burn Time	. 1	29										
(5	Meight (gms												
(5	Weight (gms First Fire				-								
	Composition						1	7					
	Additives		0	Tin			T in						
on	Other	m J	10	I		10	H						
siti	Coolants	H H	6			6			10				
pod	TazibixO		18			8	$\neg$		0				<u> </u>
om	Secondary	400 400				18			10				
ot C	Binder	50	22.5			22.5			25				
Percent Composition	muisəngsM	200 325	6			6			10				
ц.	Nitrate	Ba	31, 5			31, 5			35				
	Date		5/12			5/72	-						
	Number Test								5/72				
	Serial		39			40			41				٠.

#### APPENDIX C

TEST SERIES 2 - GREEN FLARE COMPOSITION DATA

Test Series 2 - Additives Replacing Components in Baseline Formulation

1	-		1					- 0						
		· X .		monium			omic	mpatible		ol. Re-			r (	
		Configuration and/or Remarks		Replacing binder with ammonium	ng green.		Replacing binder with chromic chloride. Green plume - some	12 0	Mix got hot spontaneously.	Slightly better than control. Re-			No burn - replacing Cr for	
				Rep	Pulsatir		Rep	bett	Mix	Slightly			No burn	O
		Static or Flight Test	,	S			S		<u> </u>	S			S	
-		Candlepower		-	-	-	-	-				<del> </del>	101	-
1		Intensity												
-		Land Test				-	1	-	-	-	-	-	-	
		Water or		≽			≱			≥			≽	
		Color Quality		fair			good	2000		good		1		
-		(sos/ini)	gi-	म्यू ट			20 20			popula		-	-	
1		Burn Rate				1744								
-		(seconds)		0			34			3 .		-	E	
L		Burn Time		180			3			93			no burn	
	(	weight (gms		7			2	de		2	de		1	
-		First Fire		1/2		v	1/2	.E		1/2	ri		1/2	
	(	Composition Smy (gms)		0				Chloride			Chloride		1 1	etal
-		Additives		09			9			09			09	et
	u	Otner		0			15	mic	,	5	mic		10	m N
	sitic	z Coolants	HCL	25			10	Chromic		10	Chromic	-	10	Chrom M
	mpo	Secondary Uxidizer	131	20			20			20		7.	20	
	Co	Binder		10	7		10	_			$\neg$			
	ercent Composition			-	-		_	-		25			10	
t	Per	2		10		-	10			2	-		0	
	-	eterti V	Ба	35			35			35			35	
	1	Test	-	5/72			5/72			5/72			5/72	
_		Number	-+		-+			-			-		5	
		Serial		42			43			4			45	

DATA SHEET Test Series 2 - Additives Replacing Components in Baseline Formulation

						i.						A PACIFIC	4
4	Configuration and/or Remarks		No burn - replacing chromium for magnesium.			Replacing chromium for magnesium.	00		Replacing magnesium with zirconium, No burn,			Replacing magnesium with	بدا
	Flight Test		S			S		1			-	-	
-	Static or	-+	-		-	01	-	-	N	-	-	S	
	Intensity												
	Land Test		A			A		1	A		1	5	1
-	Quality Vater or		-			-		-	>		-	<b>&gt;</b>	
	Color					fair poor						poor	
-	(in, /sec)	-	-			मा ०		-	-		-	<u>a</u>	
-	Burn Rate												
	(seconds)	no	burn			00							
-	Weight (gms) Burn Time	-   4				100		-					
	First Fire		1/2	etal		1/2	etal		1/2	ď		12	
-	(gmg) Jugio W									iun			in
-	noitisoqmoo		9	OLO ULO ULO ULO ULO ULO ULO ULO ULO ULO		09	om		09	on		09	no
	other asylibbA		∞	Chrom M		70	Chrom M		10	Zirdonium		∞	Zirconium
	Sitio	HCL	10			10			10		•	10	
	Secondary Oxidizer Collants Co	400µHCL	20		-	20			20			20	
	Binder C		10	$\forall$	7	25	-		25 2		-	25 2	
	muisəngs M S		2 1	+		5 2	-		0 2		-	2 2	
	Nitrate . 'D		2	+	$\dashv$	10		-	-	-			
-	The second secon		35	_		35			35			35	
	Test		5/72			5/72			5/72			5/72	
	Serial 19dmuN		46	I		47			48			46	

Test Series 2 - Additives Replacing Components in Baseline Formulation

46					, ,	Hot.						٠.	
	Configuration and/or Remarks		Replacing magnesium chromic chloride.			Replacing ammonium chloride with chromic chloride. Good color. Ho		Replacing ammonium perchlorate with chromic chloride. Very good	color,		Mix heated, not pressed.		
-	Flight Test												
-	Static or		N		-	S		S			N	1	
4	Intensity Candlepowe								,				
	Land Test		<b>&gt;</b>		100	>		>			≱		1
	Water or		M			×					>		
	Color Quality		poor			good		good					
lete.	(in. /sec)	دورق.				5.0		0.0		-			
	Burn Rate			0)			4)				-	0	
	Burn Time (seconds)		103	ride		37	rid	47	•			rid	
(5	weight (gms			Chloride		7,	Chloride	7,	de		7,	Chloride	
	First Fire		1/2			1/5		1/2	oride		1/2		
	oitisoqmo ema) thais W		09	Chromic		09	Chromic	09	Chl		09	Chromic	
	Additives			ıro			ıro					hrø	
nc	Other	m 1	5	Ü		10	Ü	10	Chromic		20	Ü	
itic	Coolants	NH	10			6		10	Chi	-	10		
mpos	Secondary Secondary	. 3	20			20		10			0		
ıt Co		CA	25			25	u .	25			25		
Percent Composition		325	r.			10		10			10		
Pe	. bitrati N	Ва	35			35	-	35			35		
	Test Date		5/72			5/12		5/72			5/72		1
	Serial TedmuN		50 5			511 5		52 8			53		

DATA SHEET Test Series 2 - Additives Replacing Components in Baseline Formulation

										.,	ation.	• • • •		
		Configuration and/or Remarks		Replacing ammonium perchlorate with ammonium dichamate	yellow-green,		Replacing ammonium chloride with			Basic formulation with 10% of binder removed, burned with inculties.		Basic formulation with 10% of binder removed. Burned without	insulation. The color of this unit was better at the beginning (first	15 sec.) then became equal to 56.
		teal Tabil		S		1								
	-	Candlepower		- 01	-	+-	S	+	-	N	-	S		
		Intensity	1											
4		Water or Land Test		×			<b>A</b>		1	A		<b> </b>		
	-	Vality				-	-	-	-			4 W		
0		Color		poor	е		fair			good		boog		
		(in, /sec)			nat	74				1		-50		
4	-	(seconds)		0	ron	-	1 00	-						
		Burn Time		120	ich		48	ate		99		50		47
	(	Weight (gms		1/2	ım Dichromate		1/2	Acetate	-	72		12	-	
	(:	Weight (gms First Fire		-1			1			1		-		
	τ	Composition		09	not	2 18	09	mie		09		09		
		sevitibb A		10	Ammoni		. 1	Chromic						
	ion	Other	12		4		10	O						
	sit	Coolants	HCI	10	_					12		12		
	npc	Secondary	4004HCL	10		100	20			22.2		22.2		
	Cor		. 1	_	-			-				2		
1	int		TA	25			25			15.		15.		
	Percent Composition	muisangsM	325	10			10			12		12		
	P.		Ва	35			10	1		38.9				
-		Date	m				3	-	_	2 38		2 38.9		
		Test		5/72			5/12			5/72		5/72		
		Number		54			22			56 5		575		
L		Serial		1 1						1.11		7.1		

40MM FLOATING FLARE

Test Series 2 - Additives Replacing Components in Baseline Formulation

	1		-											11
		Configuration and/or Remarks		Burned with liner, Basic		Burned without liner. Basic formulation Little different	10	Replacing magnesium with	The state of the s		Replacing magnesium with		Replacing magnesium with	• • • • • • • • • • • • • • • • • • • •
		Flight Test		S	-	S		1,0					S	
		Static or		+		+ -	-	N		-	N		01	
		Intensity												
		Land Test		M		Ý	1			1			1.	
		Ouality Nater or					-	≱			<b>⋈</b>		≥	
		Color						poor			poor		poor	
		(in. /sec)				-		l å		+	<u>ā</u>		<u>a</u>	
		Burn Rate												
		(spuoses)						26			2		75	
1	-7	emg) JugioW omiT mud						6			75		2	
1	,	First Fire		1/2		1/2		1/2			1/2		1/2	
1	(	Weight (gms						-	8	-	-		-	
_	1	Composition		09		09		09	nium		09		09	
		Additives					212	2	T itar					
	on	Other	m. 1					4,	H		72		2	
	Composition		HCL	10		10		10			10		10	
	odu	Oxidizer	13	20		0				j				
	Con	Secondary	-			20		20			20	_	20	
		Binder	TA	25		25		25			25		25	
	Percent	muisəngsM S	325	10		10		5			2		2	
	Д.		Ба	35		35		35			35		35	
		Date		/72		/72	-	/72				-	2	
-		Number	+	70	$\dashv$	5		5			5/72		2/5	
		Serial		58		59		09			61		62	
-	_				1		- 1	1						

#### APPENDIX D

NIGHT VISIBILITY GREEN FLARE TEST DATA

# APPENDIX D - 40MM FLOATING FLARE

3500-Meter Night Visibility Test

	1			+	= m										
		Configuration and/or Remarks	Weather - Clear night - slight ground haze; visibility > 10 miles.	1 gram 100% first fire	olor di	1	•	Very intense green, no question in identifying color, Color - too	IC K	because of its intensity. It has several disadvantages.			Not as intense as 64. Color richer than 64, not as rich as 63.		Boric Acid Intense green, No question in identifying color, Not as intense as 65, Color richer than 65, Heavy slag, formed in unit.
			Static		N			N				N			S
		ror Test	Water Land	4 2	. >		1.	M				×			A
		X.	Color		good			good				good			good
	_	(55)	s/.ni)		20			8				80	+		98
)		Rate	Burn (seco												-
		J. ime	uing		51	ride		29		1		48			62
	(	Fire smg) tr	First Weigh	1/2	1/2	mic Chloride		, 2/				1/2			1/2
	(	smg) th	Meigl W	09		- i		0					c Acid		
		lyes	Addit	9	09	lg-		09				09			09
	nc		Other		10	Chro	•					10	Bori		20
	sitic	sque	Cools	HCI	6				4			0	,		4
	npo	ndary	bixO		18			9.5	NO.	1		CIC CIC			7.6 KCLC
	Percent Composition	CA TA		50 4	22.5 1	_	1		4.2	+		928.4 PVC KCL	∞ . <b>4</b>		VC 44 K
	cent	muisən		-	9 2	-	-	5/7242.131.612.6	4,	-	+	28.4 PV	18 3.8 TA		G18 3.4 FA
	Per				12	-	-+	131	7		$\dashv$	928	5		725 G1
			Nitra	Ва	31.			42.				37.			33.
		~ :	Test		2/5		45	5/12				5/12 37.		•	5/7233.
			Seria		63			. 49							
L		10	:""5		0			0	-			65			99

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				.X										
	Configuration and/or Remarks	Weather - Clear night - slight ground haze; visibility > 10 miles.	1 gram 100% first fire	Z grams 50% first fire 50% flare mix Color distinctly better than control	intense as control, Intensity not adequate.		Very intense green, Very easy to acquire and identify			e green, col	to compare to control.		Intense green color, Some better	10,01
1:		Static	I	S	1		S			S			S	
	-							1					+	
		Water		<b>→</b>			<b>A</b>	+	$\vdash$	M	-	1	M	1
	Λq	lilanC		good			good	+	_	poog		+	poog	-
		(in. /s		90	+		1 8	-	-	8	-	+-	80	-
ć		Burn (seco	_	-	0		-	-	-				-	ļ
	miT	Burn		47	rid		26			46		v	55	
		First Reigl	1/2	1/2	Chloride		1/2			1/2	p		1/2	
(sw	व्र) उप	Bis W	0	10	nic						Acid			Adid.
		Addit	9		Chromic		09			09	Boric	-	09	Boric
		Оғре		10	Ü					10	Bo		20	Bo
siti		Cool	NH	6			04			o	4		0	+
odu A	ndar	Seco	AP NH3 400 HCL	20 AP			6 9.5 CKCL			8.6 KCL			76 KCLC	
Cor		Bind			TA		9. N	2 A			8 A		-	4 4
cnt				-	H		612,6 PVC	4.F.		4	3.8 TA			3.4 TA
Percent Composition	iisəu	Mag	325			,	31. G18			28. G18			25.3 G18	
Д.	ate	Nitr	Ва	31, 5			5/72 42.1			7.9				
-		Date		722/			122/			5/12 37.9	4		5/7233.7	
		Mum		70	-	-							12/	
		Seri		67	-		-89			69			70	

3500-Meter Night Visibility Test

52			×	•,										
	Configuration and/or Remarks Weather - Clear night - slight ground haze; visibility > 10 miles.		Chromium. Color - white at first then fading to green-blue-white	More intense than control.										
	Static or			-		-	+	+	•		-			-
	Water or Land Test		, ≽				+	+						7
	Color Quality		good				$\vdash$	$\dagger$						
-	(sest, mi)		लिस				+	+						
	Burn Rate		55		·	-	-	+				×.		
•	smirn Time Smirn Time	1/2	1/2	e Metal			-	+	-					2
	Weight (gms First Fire	60 1	09	ne M			-	+	$\dashv$					
	aevitibb A Noitieoqmo O	9	10 6	Chrome			-	+	1					
ition	Coolants	H <sub>3</sub>	6					+	1				4	
Percent Composition	Secondary Oxidizer Coolants	OOMH N	18 AP					+	$\dashv$					
Con		50 4	22.5   CA					+	1			-		
cent		325	0 2	-				+	$\dashv$					
Ъе.	Nitrate	Ba 2						+	+					
	Test	-	5/12 31.5			-		+	+	$\dashv$				
	Number		71 5,	-	-	•		+	+			-		
	Serial		-								i			

#### APPENDIX E

TEST SERIES 3 - FLARE COMPOSITION DATA

APPENDIX E - 40MM FLOATING FLARE
Test Series 3 - Multiple Substitution

-				~			.,							+
	Configuration and/or Remarks	The tip end of the plume was a deep green. The best to date. The	ित			Unit smoked, No flame,	Very interesting, bright, Color good,		Very intense, bright, Color good.		White-green plume, very intense, very hot. Most intense flare to	date. Note, G18MAG is 30/50 mesh ratio.	White-green plume, intense, good green in reflected light, hot. Moderate slag.	
	Flight Test													T
	Static or	S		S					<u> </u>		ß		N	1
1	Candle powe													
-	Land Test Intensity		-	-	-					-				+
	Water or Land Test	M	e V	×							≱		≽	
	(			fair			good		good		good		M pood	1
	Color	fair	San James Stranger	fa			8		8		80		80	-
	Burn Rate (in, /sec)				, 305	is .								1
	(seconds)	- 2		10		-			10		-	-		1
1	Burn Time	162		75			09		45		39		53	
(5	smg) tagisW			2			7,		7,7		7,	·	7,	1
	First Fire	1/		1/2			1/2		1/2		1/2		1/2	
	Composition smg) thgis W	60 1/2	m T	09	~		09	er	09		09		09	i
-	Additives			·		1			-	-	-			1
_ c	Отрет	20	CrC	20	CrCI		2	Copp					10	
Composition	Coolants	10		5						04	,	0,4	74	
pos	TasibixO	0							0	KCL	5.	H	9 T	
om	Secondary			0		73			10	X	6.	KCL	% KC %	6
	Binder	25	ou	25%	uc	PVC 40	15 PVC		16	PVC		PVG	411.3	DAG
Percent	muisəngsM	10	Boron	15%	Boron		15		20		31, 6	G 18	928.4	
Ъ	Nitrate	35		35		09	99		50		42.1		6/72/37.9	
	Date	21/9		22		2			2				22,	1
	Test	19		21/9		21/9	21/9		2/9		21/9		19	
	Number	72		73		74	75		9		2	٠.	00	
	Serial	7		7		7	1		16		77		78	1

# Test Series 3 - Multiple Substitution

15										
White-green plume. Good green i reflected light, hot, lot of slag.	Equal to control formulation. Note: G16MAG is 200/325 mesh	ratio.	Teflon binder - poor color - yellow-white. 37.5 CP intensity.		Control formulation.		G16 Mg for binder. Color = control.		G16 Mg for binder. Color = control.	
1					S		S		S	
	-	-	r <sub>U</sub>	-	rU.		-	-	-	
			37.		17.		5.7		25(	
					×		N			
	10		14	-	-		-			namen property to be a sufficient of the sufficient of
000	300		000							
	1								1	
12	75		87		55		63		45	
	-	-	-	-	-		-			
1/2	1/2		1/2							
	. 9		9							
20					0		0		0	
	-									
04	10		10		10		10		10	
9. IJ	0	d,	0	Д		Д		Д		Д
14 (2)  			2	Y.	2(	A	5(	A	5(	AP
9 3.4 PVC T^	25 CA	QR.	25	Tef	25		20		15	
35.3	10	G 16	10		10	G16	15	316	20	G16
33.7	35		35		35		35		35	
	-		Name and Address of the Owner, where the Party of the Owner, where the Owner, which the Owner, where the Owner, which the Own							
19	9	-	19		19		19		19	
19	80		81		82		83	•.	84	
	6/72 33.7 25.3 3.4 7.6 20 60 1/2 71 good W S White-green plume. Good Good W G18 PVG KCLO4	6/72 33.7 25.3 3.4 7.6 20 60 1/2 71 good W S reflected light, hot, lot of slag.  G18 PVC   CL   CA   C   C   C   C   C   C   C   C	6/72 33.7 25.3 3.4 7.6 20 60 1/2 71 good W S White-green plume. Good green FIA TA RCLO4	6/72 33.7 25.3 3.4 7.6 20 60 1/2 71 good W S white-green plume. Good green FL Color of slag.  6/72 35 10 25 20 10 60 1/2 75 good W S S white-green plume. Good green FL Color of slag.  6/72 35 10 25 20 10 60 1/2 87 poor 37.5 Teflon binder - poor color - gellow-white. 37.5 CP intensity.	6/72 35.725.33.4 7.6 20 60 1/2 71 good W S reflected light, hot, lot of slag.  6/72 35 10 25 20 10 60 1/2 75 good  6/72 35 10 25 20 10 60 1/2 87 poor  6/72 35 10 25 20 10 60 1/2 87 poor  6/72 35 10 25 20 10 60 1/2 87 poor  6/72 35 10 25 20 10 80 1/2 87 poor  6/72 35 10 25 20 10 80 1/2 87 poor  6/73 35 10 25 20 10 80 1/2 87 poor  6/74 35 10 25 20 10 80 1/2 87 poor  6/75 35 10 25 20 10 80 1/2 87 poor  6/75 35 10 25 20 10 80 1/2 87 poor  6/76 35 10 25 20 10 80 1/2 87 poor  6/76 35 10 25 20 10 80 1/2 87 poor  6/76 37.5 CP intensity.	6/72 33.7 25.3 3.4 7.6	6/72 33.7 25.3 3.4 7.6 20 60 1/2 71 good W S White-green plume. Good green By Equal to Control formulation.  6/72 35 10 25 20 10 60 1/2 75 good S/2 S Teflected light, hot, lot of slag.  6/72 35 10 25 20 10 60 1/2 87 poor 37.5 Teflow-white. 37.5 CP intensity.  6/72 35 10 25 20 10 0 55 W 17.5 S Control formulation.	6/72 33.7 25.3 3.4 7.6	6/72 33.7 25.3 3.4 7.6	6/72 33.7 25.3 3.4 7.6

40MM FLOATING FLARE

Test Scries 3 - Multiple Substitution

			11		II								
	Configuration and/or Remarks		G16 Mg for oxidizer ratio. Color control.		G16 Mg for oxidizer ratio. Color control.		G16 Mg for NH <sub>4</sub> CL.		G16 Mg for NH4CL.		G17 Mg for G16 Mg unit chuffed.		G18 Mg for M16 Mg unit chuffed.
	Static or Flight Test		ß		w		ß		ß		S		w
J	Intensity Candlepowe		9		259		95.5		809		14.7		56
	Water or Land Test		M		A		M		M		N <sub>r</sub>		8
	Color Quality												
	Burn Rate (in, /sec)												
2 V	Burn Time (seconds)		59		42		61		40		93		120
(8	First Fire Weight (gms												
	Composition Weight (gms												
-	other sevitible		0		0		0		0		0		0
ition	Coolants		10		10		5		0		10		10
sodu	Secondary Oxidizer		18.1		16.3		20		20		20		20
t Cor	Binder		25		25		25		25		25		25
Percent Composition	muisəngsM	*	15	G16	20,	G 16	15	G16	20	G16	10	G17	10 G18
Pe	Nitrate		31.8		28.6		35		35	7	35		35
	Test Date		6/12		21/9		22/9		21/9		22/9		22/9
	Serial Number		85		98		87		88		89		06

Test Series 3 -- Multiple Substitution

	Configuration and/or Remarks		G18 Mg for NH <sub>4</sub> CL. Color = control. Same slag formation.		G18 Mg for NH <sub>4</sub> CL. Color = control.		$400\mu$ AP for Ba(NO <sub>3</sub> ) <sub>2</sub> . Color = control.		$400\mu$ for B <sub>a</sub> (NO <sub>3</sub> ) <sub>2</sub> . Color = control. Faded toward end.		400 $\mu$ for NH <sub>4</sub> CL. Color = control. Small plume.		$400\mu$ AP for NH <sub>4</sub> CL. Color = control intermittent flame.	
	Static or Flight Test	1	S											1
I.	Candlepowe		1				4		6.1				-	-
	Intensity		51.		210		12.				16		14	
	Land Test		>											
	Quality Water or		-		-		-		-					-
	Color													
	(in, /sec)													7
	Burn Rate													
	(spuoses)		06		61		89		123	4	74		74	
(5	Weight (gms amiT nrud	-	-						112					-
,,	First Fire				1/2		1/2		1/2		1/2		1/2	1
(5	Weight (gms	-			0						-		-	1
τ	Composition				9		09		09		9		09	
	Raditives		0											
n	Other				0		0		0		0		0	
sitic	Coolants		25				10		10		25		0	
odı	19zibixO	1					10							
on	Secondary		20		20		25		30		25		30	-
nt C	Binder		25		25		25		25		25		25	
Percent Composition	Magnesium		15	G 18	20	G 18	10	G 16	10	G16	10	G16	10	
Д	Nitrate		35		35		30		25		35		35	
14	Test		21/9		21/		22/		2/9		22/		6/72	1
	Number		9		9	-	9		9		9		9	-
	Serial		91		92		93		94		95		96	
The second name of the second name of	A STATE OF THE PARTY OF THE PAR										and a second			_

40MM FLOATING FLARE

Test Series 3 - Multiple Substitution

	Configuration and/or Remarks	*	600µ AP for 400µ AP. Color = control. Flame went out toward	end of burn.	250µAP for 400µAP. Color = control. Questionable data point.		250µAP for 400µAP. Color = control.		$250\mu$ AP for 400 $\mu$ AP. Color = control.		55µ AP for 400µ AP.	age a	$250\mu$ AP for $B_a(NO_3)_2$ unit chuffed itself out.
	Static or Flight Test												
J	Intensity Candlepowe		13,4		67.9		10.4		8.3		5.2		7.4
	Land Test	-			-								10
	Water or	- 12											
	Color Quality												
	(in, /sec)		-	-					-				
	Burn Rate				-								
	(seconds)		77		50		6		7(		43		1
75	Weight (gms Burn Time				1/2 120		1/2119		1/2 107		1/2 143		01
1	First Fire		1/2		1/2		1		1/2		1/		1/2
(5	Weight (gms		09		09		09		09		0		09
U	oitisogmoD		9		9		9	<u>.                                    </u>	9		09		9
	a sylitibb A		0		0		0		0		0		0
on	Other	·			-		-	-					
siti	Coolants		10		10		10		10		10		10
bos	Oxidizer												
om	Secondary		20		20		20		20		50		25
nt C	Binder		25		25		25		25		25		25
Percent Composition	muisəngsM		10	G16	10	G16	10	G16	10	G16	10	G16	10 G16
Ъ	Nitrate		35		35		35		35		35		
	Date		2/9		21/9				21/9		21/9		6/72 30
_	Test		9		9	-	21/9		1		19		9
	Serial Number		26		86		66		100		101	, .	102

Test Series 3 - Multiple Substitution

			T	Г		I	T				Г	
	Configuration and/or Remarks		250μAP for B <sub>a</sub> (NO <sub>3</sub> ) <sub>2</sub> . Slight		250μAP for binder. Color = control.		250µ AP for NH <sub>4</sub> CL. Color = control.		Ba(NO3), for NH4CL. Color -	control,	$B_a(NO_3)_2$ for $NH_4CL$ . Color = control.	$B_a(NO_3)_2$ for $NH_4CL$ . Color = control.
	Flight Test											/
	Static or											 
J	Candle powe		6.6		8.6		19		5.6		17,8	09
	Intensity		-		-		-				-	 -
	Water or Land Test	3										
	Quality					-			-			
	Color											
	(in, /sec)											
-	Burn Rate	-										 
	(seconds)		119		81		99		13		69	51
(s	Weight (gms Surn Time		2 1						1/2 113			 
,	First Fire		1/2		1/2		1/2	-	1		1/2	1/2
(5	Weight (gms		09		09		09		09		09	 09
υ	Composition		9		9		9		9		9	9
	Additives		0		0		0		0		0	0
n	Other											
Composition	Coolants		10		10		10		15		2	0
bog	TasibixO											
om	Secondary		30		25		30		20		20	20
nt Co	T əbni E		25		20		15		25		25	25
Percent	Magnesium		10	G 16	10	G 16	10	G 16	10	G16	10	10
Д	N itrate		25		35		35		30		40	45
	Date	,			2						-	
	TesT		2/9		21/9		21/9		21/9		21/9	22/9
	Number		103		104		105		106		107	108
	Serial		1		11		10		10		10	10

40MM FLOATING FLARE

Test Series 3 - Multiple Substitution

	-	-	-	7	·		,							-
		Configuration and/or Remarks		G18 Mg for NH <sub>4</sub> CL, 250µ AP for 400µ AP. Some slag.	1	G18 Mg for G16. 250µ AP for 400µ AP.		250 AP for NH <sub>4</sub> CL. G18 Mg for G16 Mg. Good color. Slow rise		250μ AP for NH <sub>4</sub> CL. G18 for G16. Good color. Some slag.	p	G18 for NH <sub>4</sub> CL and 250µ AP for 400µ AP. Bright - good color.		Gran 18 Mg for $NH_4$ CL. $600\mu$ AP for $400\mu$ AP.
		Static or Flight Test		S		S		ß		S		S		S
	J	Intensity Candle powe	2	49		7.3		16.1		16		150		32
		Land Test				> ≽				M		M		≽
		Water or		≥		7.		×		1				
		Color Quality		good		good		good		good		good		good
-		(in. /sec)				-		- 500				00	1	100
		Burn Rate												
		Burn Time (seconds)		88		18		66		84		64		82
*	(5	Weight (gms		,2		1/2 118							-	
		First Fire		1/2		1/		1/2		1/2		1/2		1/2
-	(5	Weight (gms		09		09		09		09		09		09
1	τ	Composition	-	9		9		9		9		9		9
	ц	1941O reavitibb A		0		0		0		0		0		0
	sitio	Coolants		5		10		5		0		0		2
	bog	Oxidizer												
	om	Secondary		20		20		25		30		50		10
	nt C	T əbni A		25		25		25		25		25		25
	Percent Composition	muisəngsM		15	G 18	10	G 18	10	G18	10	G 18	20	G18	15 G18
	Ъ	Nitrate		35		35						35		35
1	-	Date		98/22/9		2		6/72/35		972/9		2		2
		TesT		19		21/9		19		19		21/9		2/9
		Number		6		- 1								
		Serial		109		110		目		112		113		114

Substitution
- Multiple
3
Test Series

	Configuration and/or Remarks	Gran 18 Mg for NH,CI. 600, AP	H		Gran 18 for Gran 16. 600 AP for 400 u.		Chromic acetate for NH,CL.		Chromic chloride for NH <sub>4</sub> CL. G18 Mg for G16.		119 through 122 increasing press	1	Some slag formation,
	Static or Flight Test		S		S	,	S		S		S		S
J	Intensity Sandlepowe		107		7.2		41.1		20.75		57 8		38
	Land Test		W		M		W 4		W Z	2	>		M
	Quality Water or	$\neg$	good		poor		poor		good		boog	-	good
	Burn Rate (in, /sec) Color	1	90		_d		Ď		20		900	1	20
	emiT nind (sbnoces)		64		129		1/2 41.1		71		89		91
,	First Fire Weight (gms	,	1/2		1/2 129		1/2		1/2		1/2		1/2
	Composition (gms)		09		09		09		09		09		69
n	TediO Additives		0		0		10		10		0		0
sitio	Coolants		0		10		0		0		2		105
Composition	Secondary Oxidizer		07		20		20		20		20		20
	Binder	1	97		25		25		25		25		25
Percent	Magnesium		07	G 18	10	G18	10	G18	10	G 18	15	G18	15 G.18
P	N itrate		35		35		35		35		35		35
	Test Date	1	7)/9		21/9	4	21/9		21/9	*	22/9	-	21/9
	Serial TodmuN		115		116		117		118		119		120

Test Series 3 - Multiple Substitution

											4	0.0	
	Configuration and/or Remarks		Some slag formation	Some slag formation	Tested with ballute, fair inflation, slagged up	Tested with ballute, slagged up	Delay failure	Good ignition, slagged up in mid burn, after slag ejection flame	good, range approx 300 meters	Delay failure	Good ejection, good inflation, som slag formation. This formulation	is satisfactory except for slagging	BaNO3 sub for AP; Very little slag but unit chuffed.
	Static or Flight Test		ß	S	S	S	দ	দ		দ	ഥ		w
16	Intensity Candlepowe		39	28									
	Water or Land Test		M	W	W	W	W	W		W	M I		<b>≯</b>
	Color Quality		good	good	good	good		good			good		good
	Burn Rate (in. /sec)												•
	Burn Time (seconds)		94	96	92	92		80			06		119
(s	erirst Teri mg) Jugie W		1/2	1/2	1/2	2/3	2/2	2/2		2/4	2/4		1/2
	oitisoqmo⊃ mg) thgi∍W		20	02	09	09	09	09		09	09		09
а	r 9dt O R dditives		0	0	0	0	0,	0		0	0		0 .
sitio	Coolants		2	5	2	2	5	2		2	ς.		70
oduu	Secondary Oxidizer	AP 400	20	20	20	20	20	20		20	20		30
nt Cc	Binder		25	25	25	25	25	25		25	25		25
Percent Composition	muisəngsM		358	15 G18	15 G18	15 G18				15 G18	-		G18
Д	Nitrate		2 35	2 35	2 35	2 35	2 35	2 35		3 35	2 35		2 25
	Test Date		12/9	6/72	2/9	2/9	2/9	6/72		6/72	6/72		27/9
	Serial Number		121	122	123	124	125	126		127	128		129

40MM FLOATING FLARE Test Series 3 - Multiple Substitution

										- 50	T		.c
	Configuration and/or Remarks		BaNO3 Sub for AP; some slagging	BaNO3 sub for NH4CL; some slagging but expelled easily.	BaNO3 sub for AP	Slag formed, some expelled.	Binder sub for NH4CL; some vellow in flame.	Mg sub for BaNO3; good color; expelled slag ok.	Expelled slag well; smooth burn; good color.	Chuffed loudly; flame green during	Good color; some chuffing; expelled	slag ok.	Chromic Acetate added 10% for each component.
	Static or Flight Test		S	S	ß	S		S	ß	S	S	S	ß
Ţ	Intensity Candlepowe		20	59	30	62		101	94	39	63	41	123
	Water or Land Test.		≥	≽	×	>		×	>	×	×	×	≽
A PARENT AND A PAR	Color Quality		good	pood	good	good	good	good	good	fair		good	good
an Amelian Land	Burn Rate (in, /sec)		1				Olley						_ w
	Burn Time (seconds)		93	29	69	70	118	77	98	120		87	62
(s	First Fire Weight (gm		2/4	2/4	2/4	2/4	2/4	2/4	2/4	2/4	2/4	2/4	2/4
	Composition Weight (gms		09	09	09	09	09	09	09	09	09	09	09
-	Other Additives		0	0	0	0	0	0	0	0	0	0	10
sition	Coolants		2	0	r.	0	0	0	0	0	0	0	0
mpo	Secondary Oxidizer		25	20	15	30	20	20	25	30	25	22. \$	22. 5
t Co	T 9 bri d		25	25	25	25	30	30	30	30	30	30	27
Percent Composition	muisəngsM		15 G18	15 G18	15 G18	20 G18	15 G16	20 G18	20 G18	20 G18	20 G18	22. 5 G18	18 G18
Pe	Nitrate		30	40	40	25	35	30	25	20	25	25 2	22.5
	Test	-	6/73	6/72	6/72	6/72	6/72	6/72	6/72	6/72	6/72	6/72	6/7222.5
-	Serial redmuN		130	131	132	133	134	135	136	137	138 (	139 (	140

40MM FLOATING FLARE

Test Series 3 - Multiple Substitution

										1.0		. 0	
	Configuration and/or Remarks		Units functioned satisfactorily; 5 sec delay.	5.5 sec delay	5.0 sec delay	5.5 sec delay	5.5 sec delay	3.5KM night visibility tests 146 thru 149. More intense than control:	color not as good as control. This formulation satisfactory except	for color quality.	Chrom Acetate additive	Chromic Chloride additive; color slightly better than Chromic Acetate	however, because CrCL3 is incompatable with Mg Chromic Acetate is the better additive for color.
	Static or Flight Test		দ	দ	দ	দ	দ	S			S	S	
a i	Candlepowe											-	
	Intensity												
	Water or Land Test	*	×	W	W	W	W	W			M	×	
	Color Quality		good	good	good	good	good	good			good	g00d	
-	(in. /sec)		good	-504-			out -					- 30	
	(seconds) Burn Rate		66	)5	6	2	88						
70	9miT nru8			10	4 89	1 85		₹					
(2	First Fire Meight (gm		2/4	2/4	2/4	2/4	2/4	2/4			2/4	2/4	
	Weight (gm		09	09	09	09	09	09			09	09	
u	eavitibb A oitieoqmo D		0	0	0	0	0	-					
nc	Other							0			10	10	
sitic	Coolants		0	0	0	0	0	0			0	0	
Composition	Secondary Oxidizer		25	25	25	25	25	25			22. 5	22. 5	
	Təbnid		30	30	30	30	30	30			27	27	
ercent	muisəngsM		20 G18	20 G18	20 G18	20 G18	20 G18	20 G18			18 G18	18 G18	
Ре	N itrate		25	25	25	25	25	25			r.	rU	
	Test Date		6/72	6/72	6/72	6/72	6/72	6/73			6/7222	6/7222.	
	Number		141	142 6	143 6	44 6	45 6	46 6			47 (	48 6	

DATA SHEET

40MM FLOATING FLARE

Test Series 3 - Multiple Substitution

			-											0.5
		Configuration and/or Remarks		Chrome plated chimney. Color slightly better than with a boxes		Good color; some slag.	acid	Slagged up after approx 15 secs.	Large radius machined at the base of the chimner Slagged	Slagged up but expelled ok.	Slagged up; poor function.		Slagged up, expelled same - not	Last 2/3 of burn was good color.
		Static or Flight Test		S		S	S	S	S	S	S			
	J	Intensity Candlepowe				40	38	35	40	15.5	12			
		Land Test		A		×		8	>	W		<b>A</b>		
2 -		Quality Water or			-	Po	00	P	00	H	H		च	니면
		(in, /sec) Color		good		good	good	pood	good	fair	poor	good	good	fair
		Burn Rate												
		Burn Time (seconds)				98	69	99	69	152	93	33	82	66
-	(5	First Fire Weight (gms		2/4		2/4	2/4	2/4	2/4	2/4	2/4	2/4	2/4	2/4
-		Composition Weight (gms		09		09	09	09	09	09	09	09	60 2	09
-		reht O sevitibb A		0		0	2	0	0				0	0
	ition	Coolants		0		2	0	0	2	15	15	2.5	2	7.5
	Composition	Secondary Oxidizer		25		20	20	25	20	15	15	527.5	20	. 02
		Binder		30		25	25	25	25	25	20	27. 5	25	25
	Percent	muisəngsM		20 G18	·	15 G18	15 G18	15 G18		15 G18			G18 15	18
	Pe	Nitrate		25		35	35	35	35	30	30	30 1	35	35 12 G
-		Test Date		6/72		6/72	6/72	6/72	6/72	6/72	6/72	6/72	21/9	22/9
1		Serial		149 6		150 6	151 6	152 6	53 6	54 6	155 6/	9 951	9 251	9 85

Test Series 3 - Multiple Substitution

						-								
		Configuration and/or Remarks	Slagged up.	Expelled slag o.k,	Slagged up,	Unit functioned o.k. Expelled large chunk of slag.	,=		Unit did not expel slag. Ballute ruptured at 30 sec., unit sank.	expel slag.		Good - color somewhat yellow.	Ejected 75 feet from gun. Unit burned under H <sub>2</sub> O.	Five second delay - unit functioned satisfactorily.
		Static or Flight Test				ĹŦ	Ĺti	[H	[H	. <u>Г</u>	S	S	년	[4
	J	Candle powe		180	46								Н	
	1	Land Test Intensity		-	-	-	≥	≥	≽	8	61	104		
		Water or			L.,,	×					≥	A	∌	≱
ordinana.		Color Quality		good	good	good	good	good	good	good	good	good	good	boog
		Burn Rate (in, /sec)												
		Burn Time (seconds)	71	72	72	02	75	75	-	,	75	73	75	71
	(5	Weight (gms									-			
-	1	Weight (gms First Fire			2/4	2/4	2/4	2/4	2/4	2/4	2/4	2/4	2/4	2/4
,	t	Composition	09	09	09	09	09	09	09	09	09	09	9	09
Ī		Other Additives	0	0	0	0	0	0	0	0	0	0	0	0
	ition	Coolants	. 10								2.5	0	0	0
	Composition	Secondary Oxidizer	20	25	20	25	25	25	25	25		0	0	0
	Cor	T sbni a	25 2		30 2		10	5			5 20	0 20	0 20	0 50
	Percent	muisəngsM	5		. 5	182	182	25 G18 2	25 G18 25	25 G18 25	. 5 18 25	20 G 18 30	20 G 18 30	20 G 18 30
	Per	N itrate	5 G		5	.,,					17 G			
-		Date	3	2 25	2 32.	2 25	2 25	225	2 25	2 25	35	2 30	2 30	2 30
		lasT	21/9	21/9	21/9	21/9	21/9	21/9	22/9	22/9	21/9	21/9	22/9	08 22/9
	0	Serial Number	159	160	161	162	163	64	165	.66	.67	68	69	20

Test Series 3 - Multiple Substitution

	_		le d	T	T	T	T	m i	7	7	T	To	T	T
		Configuration and/or Remarks	4.9 second delay. Ballute ruptured, unit sank.	4.7 sec delay. Unit functioned o. k.	7.4 second delay, Ejected under H2O. Functioned o.k.	n night test.	Much buighton Donasolo	1	Some better.			Greener, better, Chrome Chlorid reacts with Mag.		
110		To State of Test		[F4	1	,	1		70				70	S
rrario	J	Candlepowe		-	[H	N	1 0 4	, v	4	01	S	S		
Stil		Lntensity					2		more	same			same	same
- Multiple Substitution		Land Test		<b>&gt;</b>	W	, ,								
		Quality Water or	- 1	A P		<b>№</b>	M	+	0	×	3	≥	×	M
		Color	good	good		good		er.	1	as		1	same	same
M. W.		(in, /sec)		1				better	better	Not as			0,	6
rest Series 5 - IV		Burn Rate		-				-	Q	Z				
		Burn Time		72	77	92					50-	-09		
	(5	Weight (gms	4	2/4	2/4	2/4	2/4	2/4	4	4		-	4	4
	1	Weight (gms First Fire				_		1		2/4	2/4	2/4	2/4	2/4
	Ţ	Composition Waisht	90	9	09	09	09	rol)	09	09	09	09	09	09
	Composition	Additives						ntr			10	10		
		Other	0	0	0	0	•		0	0	1	-	0	0
		Coolants	0	0	0	0	ION 0	NO.	oney	ION	0	0	10	10
		Secondary Oxidizer	20	20	20	25			chimney.	<b>25</b>	ate 22,5	ride 22.5	20	10 rol)
		Binder	30	30	30	30	FORMULAT 0 30 25			RMOL	Aceta 27 2	Chlor 27 2	25	25 10 control)
	Percent	muisəngsM	20 G 18	20 G 18	20 G18	20 G 18	FOR 20	FORMU.	p	2gor	mic 8	mic (8	10 G18	10 G18
	Pe	N itrate	30 0	30	30 2	25 C	NEW 25	OLD 35	Chrom 25 20	25 WEW	Chromic 22, 518	Chromic 22, 518	35 G	35 L
		Date	22/	22/	/723		72 27	22/			2 2	722/	723	
-		Test	9	9	9	21/9	9	9	21/9	21/9	21/9	/9	21/9	6/72
		Serial 19dmuN	171	172	173	174	175	176	177	178	179	180	181	182
_							-						1	

Test Series 3 - Multiple Substitution

-			-										**	
	Configuration and/or Remarks				Burn with control round.	Control round.	Burnalone		Fog coming in.			Delay 5.2 sec. Unit tumbled, laid on side in water.	Delay 5.2 sec. Unit wobbled in	Delay 5.0 sec. Ejection o.k., sank then surfaced at 30 sec.
		Static or Flight Test		S	S	S	· v	S S	S	S		[H	[ <u>F</u> 4	Į.
	J	Candle powe		"	01	01	8000	3						
H	_	Land Test Intensity	-	-	-	-			*	Wgood	80	-		
_		Water or			≽	•≽	,8		>	×	8	M	` ≥	>
		Color Quality			good		good	good	dim	good	good	green	green	green
-		(in./sec)	_	-	00	-	80 9	B r	P	6 8	20 1	1 50	- N	1 00
_	Burn Rate													
	Burn Time (sbnoces)				95		93	06	87	105	78	95	93	91
	Weight (gms)		4	4	4	4	. 4	-			-	-	-	
-	75	Weight (gms First Fire	-	2/4	2/4	2/4	2/4	1				2/4	2/4	2/4
	τ	Composition	09	09	9	09	09					09	09	09
	d	Other Additives	0	.0	0	0	. 0				÷	. 0	0	0
:	sitio	Coolants	0	0N 10	0	10	0	5.	7.			0	0	0
	Composition	Secondary Oxidizer	ey 25	LATI 20	25	20	25	18	r 187.	.w.		25	25	. 25
Percent Co.		Təbnid	himn 30	1	30	25	30	TEST	TEST	Yellow.	Red	30	30	30
	rcer	muisəngsM	20 C	FORMU 10 25	20 G18	10 G18	20 G18					20 G18	20 G18	20 G18
t	4	N it rate	Chro	OLD 35	25	35	25	REPEAT	REPEAT	Standard	6/72 Standard	2	2	25 6
		Date	2/9	22/	77	22/	722/	1 22/9	1 22/9	S 21/9	522/	2 22/9	722/	722/
-	Number Test			0	9	9	9						9	9
Serial		183	184	185	186	187	188	189	190	191	192	193	194	

40MM FLOATING FLARE

Test Series 3 - Multiple Substitution

	Configuration and/or Remarks	Delay 5.0 sec. Ejection o.k., good performance.	Delay 5.0 sec. Ejection o.k., good performance.	Delay 4.8 sec. Ejection o.k., sank but burned.	Delay 5.0 sec. Ejection o.k., good performance.	Ignition transfer failure.	Delay 4.9 sec. Ejection o.k., good performance.	Good performance. Ballute o.k.	Delay 5.0 sec. Good performance. Ballute o.k.	Excessive gun recoil. Unit hit in mud. Ballute split seam 1 inch.			
	Flight Test					-						1	
T	Candle powe	14	Fi	14	ഥ		मि	<u> </u>	F	F		-	
st.	Intensity				-								
-	Land Test		-	Δ.	W		<del>                                     </del>					1	<del>                                     </del>
	Water or	$\geqslant$	M	` ≽	×		8	A	A	L			
	Villang	red	yellowW	greanW	yellow		red	greenW	greenW	greenL			
	Color	ř	- F	4 P	le]		H	1.6	E L	re or	·	-	
	Burn Rate (in, /sec)		>	1						۵			
	(seconds)						-				-	-	-
	Burn Time	92	115	90	115		74	80	88	94			
(5	Weight (gms			_								1	
	First Fire			2/4				2/4	2/4	2/4			
	Weight (gms		no	09	u			09	09	09			
t	Composition	đ	tio	9	tio		-	9	9	9		-	
u	reht O	Formulation	Formulati	0	nula	Formulation	Formulation	0	0	0		- 10	
sitio	Coolants	mu.	Orr	0	Porr	lnm.	mul.	0	0	0			
Composition	Secondary Vxidizer	F01			Yellow Formulation	FOI		25	25	25			
	Təbni B	Red	Yellow	30		Red	Red	30	30	30			
Percent	muisəngsM	Standard	Standard	20 G18	Standard	Standard	Standard	20 G 18	20 G 18	20 G 18			
Pe	N itrate	Stan	Stan	25	Stan	Stan	Stan	25	25 (	25			
	Date	22	22/	22	- 22	2	72	22	22	2	-4	-	
	Test	21/9	./9	21/9	22/9	21/9	6/72	21/9	21/9	21/9		1	
	Number	95	961		86	66							
	Serial	61	19	61	6	61	200	201	202	203			

#### APPENDIX F

PHASE I DEVELOPMENT AND QUALIFICATION TEST DATA

#### APPENDIX F - 40MM FLOATING FLARE

DATA SHEET

# PHASE I DEVELOPMENT AND QUALIFICATION TEST DATA

<b>—</b>	-	1	т—		1 14	T		T **	1	-	T X	M	Li .
	Configuration and/or Remarks	Good 100%;new barrel; delay OK; stability OK	Landed in mud; new barrel; good 100%; delay OK; stability OK	Good 100%; new barrel; delay OK; stability OK	Sank but burned fu I duration; new barrel; delay OK; stability OK	Good 100%; delay ok: stability OK; new barrel		First fire failed to light; de lay OK; stability OK; green	Good 100%; green	Delay chunked out; first fire failed to light; stability OK	Delay OK; first fire ignited; but vented; went propulsive; stability OK	Delay OK; first fire OK; stabilityOk bullute was cut during assy; sank	Delay OK, but vented, stability OK first fire ignited, functioned OK
	Static or Flight Test		[	ſ~.	, f=.	[H		ſ.	ſĸ.		ſv.		
J	Candle powe		Ή	Ή	দ	Щ		[H	[H	দ্ৰ	F4	দ্ৰ	[H
	Intensity												
	Land Test	M	,	W	M	W		-	1	7	1	1	_
	Quality Water or		니			>		N u	N U	1 W	Mu	N	≥ u
	Color							grn	grn	8	grn	grn	grn
	(in, /sec)												
	Burn Rate			10		_							
	Burn Time	90.5	98	90,5	92	90				Z			
(s	Weight (gm	2/4	2/4	2/4	2/4	2/4		2/4	2/4	MULATION	2/4	2/4	2/4
10	First Fire	2	2	2	2	2		2	2	A	2	2	7
	Composition Weight (gms	09	09	09	09	09		09	09	(U)	09	09	09
	Additives												
п	Other									FOR			
Composition	Coolants									MC			
800	TezibixO	200	200	70	0	2		3	760	1	30	. 3	3
mp	Secondary	25 AP 400	A25 400	25 AP 400	45 400 400	400 400	1	400%	49 40	KELLOW	25 AP 400,	40 40	25 AP 400
	Binder	30	30	30	30	30		30	30	,	30	30	30
Percent	muisəngsM	20 G18	20 G18	20 G18	20 G18	20 G18		20 G18	20 G18	STANDARD	20 G18	20 G18	20 G 18
P	Nitrate	25	25	25	25	25		25	25	STA	25 (	25 (	25
	Test Date	7/14	7/14	7/14	7/14	7/14		7/31	7/31	1/31	1/31	12/21	7/31
	Serial redmuM	204	205	506	207	208		209	210	211	212-	213	214

## 40MM FLOATING FLARE FLIGHT TEST SERIES

Old Bodies

2 (suspect separation or output mix at press interface) Delay batch no.

New ogives

4. First fire dried before pressing

all green units

						2 17					
	Configuration and/or Remarks	Control rounds; chuffed 1/2 way thru burn; functioned OK	1 GM B.P. in 1st fire; ejection lad functioned OK	Control rounds; ejection 50 ft; Chimney ejected at 66 secs.	l gm B.P. in 1st fire; delay verted no ejection; sank on impact	Control rounds; functioned OK	l gm B.P. in 1st fire; ejection loud; functioned OK	Control rounds; delay glowed but didn't spit; no ej.; sank on impact	l gm BP in 1st fire; functioned OK	Control rounds; Functioned OK	l gm B.P. in 1st fire; launcher observed nothing; DUD; ballute was
	Static or Flight Test	ſ.,	Ĺτι	Ĺ-i	ĮΉ	ĮΉ	ഥ	দ্ৰ	দ্ৰ	দ্ৰ	Ĺτι
	Delay (sec)	5.5	5.3	4.5	1	5.2	5,6	· (1;	5,5	5,3	1
	Water or Land Test	≽	≽	≽	×	×	M	W	∌	M	∌
	Color Quality	grn	grn	grn	1	grn.	grn	1	grn	grn	1
	Burn Rate (in, /sec)					-					
	Burn Time (seconds)	94	101	99	1	96	86	1	06	06	1
(s	First Fire Weight (gms	2/4	2/4/1 101	2/4	2/4/1	2/4	2/4/1 98	2/4	2/4/1	2/4	2/4/1
	Composition Weight (gms	09	09			09	09	09	09	09	09
	Other Additives										
Composition	Oxidizer	25 400 400	<b>允</b> 予 400≁	<sup>2</sup> ÅP 400≻	주 400~	} 20€	Á찬 400~	P 200	25 AP 400~	5 50 50	400 %
Com	Binder Secondary	30 A	A 30 400	30 4(	30 4(	名 30 400		30 A	30 A	30 A	30 A
Percent	muisəngsM		C18 3				-			20	
Per	N itrate		25 G	25 G	25 G	25 G	25 G	25 G	25 G	25 G	25 G
	Test Date	8/9	6/8	6/8	6/8	6/8	6/8	6/8	6/8	6/8	6/8
	Serial Number	215 8		217 8	218	219 8	220 8	221   8	222	223 8	224

3 out of 5 control rounds functioned OK 1 out of 5 control rounds were Duds Corclusion:

l out of 5 control rounds ejected the chimney 3 out of 5 B.P. rounds functioned OK out of 5 B.P. rounds were duds.

2.	New delays New magne				20 ne	w pr	oced	ure)		p			
	Ingredients	drie	d ov	auej	rht at	150	OF		-	14			
4. 5.	All green u				soft;		ľ			b allute recove			
	Configuration and/or Remarks	Ejection loud; Functioned OK	Ejection soft Functioned OK	Ejection soft Functioned OK	ght; ejection	Stable flight; ballute ruptured; Functioned OK	Wobbled slightly in flight; Full range: functioned OK	Stable flight; functioned OK	Wobbled slightly in flight; Couldn't eject slag;	; ejection loud; b	functioned OK Full range; functioned OK		
	Static or Flight Test		ഥ	[H	1	-	H		<u>н</u>	H	[r		
	Delay (sec)	5.1	4,6 sound	4.7	2.5	5.5	4.4 sound	5, 1	5.6	5.4	C	1	
-	Land Test												<del>                                     </del>
	Wateror	≽	>	≽		≥		≥	≽	≱	A		
	Color	good	good	good	grn	good	goog	good	good	good	good		
	Burn Rate (in, /sec)												
	Burn Time (seconds)	87	87	81	68	09	06	87	71	98	93		
(8	First Fire Weight (gms	2/4	2/4	4	2/4		2/4	2/4	2/4	2/4	4/	-	
(s	Weight (gms	2	2								- 01	-	-
U	Composition	90	0,9	09	09	09	09	9	09	09	09		
u	TehtO Reditibb A					Α,							
Composition	Coolants	ē											
bos	TesibixO	04	3	2	3	3	4	1	4	4	3		-
om	Secondary	24A 2010	AP 400	45°0 46°0	25 40 40 40	25 AF 40(	4 4 4 5 5 7	24 400 00,	45 40 40	25 AP 400,	AP 400,		
nt C	Binder	30	30		30	30	30	30	30	30	30		
Percent	muisəngsM	20 G18			20 G18	20 G18	20 G18	20 G18	20 G18	20 G18	20 G18		
Д	N itrate	25	25	25	25	25	25	25	25	25	2.5		
	Test Date	8/16	8/16	/16	/16	/16	/16	/16	8/16	/16	8/16		
	Serial Number	225 8	226 8		228 8	229 8	230 8,	231 8,	232 8,	233 8,	234 8,		

functioned OK.

40MM FLOATING FLARE FLIGHT TEST SERIES

6. All green units 40MM FLOATING FLARE FLIGHT TEST SERIES

New delays (4th batch 120) 1. New bodies

Ingredients dried before mixing Body burr removed 3. New ogive 4. r

tech, and proof the new batch of delays Purpose of Tests: Check out new assy

DATA SHEET

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	-			+							-		
		Configuration and/or Remarks		Full range; tumbled after ejection; burned underwater. No orifice		Full range; good ejection;burnedOK 1st 30 sec. chimney plugged for 10 sec;ejection slag & sankat 63 sec;	Full range; good ejection; tumbled slightly after ejection; sank on impa	burned 60 sec, sank; no orifice y. Fired straight up; ballute failed to inflate; seam broken, no orifice,	Full range; ejection soft; functioned OK; orifice	Full range; ejection soft; functioned OK; orifice	Full range; ejection soft; functioned OK; orifice	Full range; ejection soft; ejected on water; froated OK; functioned OK; Orifice	Full range; ejection soft; floated OK; functioned OK; orifice
		Test	Flight			1	1	1	HO	1.	HO	HVO	~
		10	Static	F	F	F4	Fi	Ft	FH	[H	দ্ৰ	[F4	5sec und B
		(sec)	Delay	5	70	4	3	8	4	3		0.	4,5se sound
			Land	70	70,	r.	ທ	70	70	r,	5	5.	80
			Water	≱	≱	. ≱	⋰≽	se L	se ⋈	se ⋈	se ⋈	se W	se
		Λ	dilan O	,		D U	n od	H	H		H	H	n n
	Neg 1	/2.2	Color	1		good	good	inter	inte	intengrung	intergr	inter grn	inter grn
	17	(29 (29	,										
			Burn Secor		-			-	-				
			Burn	94	100	63	09	87	92	97	93	95	95
	(5	mg) 11	Meigh		4			-		4			
		Fire	First	2/4	2/4	2/4	2/4	2/4	2/4	2/4	2/4	2/4	2/4
-		roitieo emg) ti	Weigh	0	0		0	. 0		0	0		
			Addit	09	09	60	09	9	09	09	09	9	9
	_	1	Other										
	Composition		Coola		,		~						
	sod	rer	ibixO	3	3	3	0	40	3	4	3	3	3
	m	dary	uosəs	4004 4004	4004 4004	400 400 400	455 400,	<u> </u>	A55 4000	25 AF 40	25 AP0	25 AP 400,	40 40
oved		1	Binde	30	30	30	30	30	30	30	30	30	30
removed	ercent	muisə	Magn	20 G18	20 G18	20 G18	20 G18	20 G18	20 G18	8	20 G18	20 G18	20 G18
Body burr	Ъ,	əj	N itra	25	25	25			25	25		25	
Q t			Date	/312	/312	/312	/3125	/3125	/312	/312	/3125	, /312	8/3125
po			Test	8	8	8	8	. /8	8/	8/	8/8	- /8	8
5. B			Seria Mumb	235	236	237	238	239	240	241	242	243	244
-							7.41	, 41	, 4		1.41	14	,41

act

O of 5 units functioned OK without orifice; 5 of 5 OK with o. Conclusion: All units assembled without orifice in chimney; last 5 units rebuilt with new ogives and the orifice added.

- Most past history did not screen the teflon before or after mixing 7. Teflon-7A used in first fire 8. Units 245-249 ballute cut during crimping Body fwd land snug fit inside gun
  - New bodies from first lot 3 %
- New delays (4th batch 120)
  - New Ogives
- 9. All green units New batch of first fire (different container of teflon) 4.

This batch has more uniform dist, because screening before adding to mix prior to this the teflon was not screened but screened after mixing.  This batch has more uniform dist, because screening before adding to mix prior to this the teflon was not screened but screened after mixing.  Configuration condition to the condition of		Functioned at water impact went	functioned OK	long range delay function, deployed	'Z sec to B' Othrew into water functioned OK	shot higher elev had trouble ejecting slag burned elevations	functioned OK	deployed in air spirled into water sank stuck in mud on bottom hole burned in ballute
Bht Tesm		745						
Tim Gate screening before adding to the form of the fo	Stat	_	6.2 F	_	7.0 F	[i	0.5 F	6.2 F
of TesT br	Del Lar	_		28	7.		0	9
Der or all	Wat		M	I S	W	111	^	M
or enin	Col	good	grn		=	=		
Sec (Ses)	ui)	50	OU				-	
a (spuos	Bu )	_	4	_	2	ır		
and mi T m	Bur		94		69	α.		113
of Fire	Fir		60 2/4		=	=		=
ilisoqu Pag) idigi			09		11	=		=
Hitives B	bA				_			
stants was	147O	_	_	_		-	-	
dizer loui		_	X				-	
ondary te		KB	400	_	=	:		=
der rebi	Bin		30		=	=		=
did inisəng	ьМ	20	G18		=	_ =		=
This batch has more uniform dist, becare prior to this the teflon was not screened gnesiumistives distince and sizer condary distince distinct dist	3i N		25 6		=	=		=
This	Dat	-	8/6		=	=	-	=
nber	Nui	_		_			-	
	261		245		246		24.1	248

106 81 = = = = = = = = = = =

=

=

=

249

=

=

=

250

deployed in air, spirled, sank cameup, 10 sec burned OK sank at 20 sec came up tilted over on side and sank

deployed in air spirled tear in ballute seam

landed on the ground

H

6

5

H

grn

good

4

9

5

×

4

8

2

 $\geq$ 

good

4

6

2

3

26

=

=

=

=

=

=

=

252

=

=

=

251

4

0

9

×

83

=

=

=

=

=

=

=

253

good. grn ×

82

=

=

=

=

=

=

=

254

water

deployed in air sank burned under deployment looked ok could have spirled

deployed in air, spirled, burn hole in ballute, sank in very shallbw water

deployed in air, spirled, burned OK tilted over in 60 sec came back up straight functioned SK

burned

deployed in air, sank,

6 out of 10 functioned OK - ballutes cut during crimping did not cause a failure underwater H 5.5 S/N 246 rifling marks on body of fwd land Conclusions:

S/N 248 tight in loading flare into body; 4 holes cut in ballute during assy Some had a double report on ejection especially S/N 252 and 253

New bodies New delays (4th batch) New ogives repacked on S/N 258 after inspection; S/N 259 repacked with original ogive; s/N 255 & 256 repacked with white ogives.

Purpose of tests: to check reason for ballute burns, torn stitching

in previous test group

			٠		pact					.,			,	
	Configuration and/or Remarks	ejection slow; full range; hit shallow water; plated OK	ejected high-sounded good; stable into water;	ejection OK - tumbled, sank, burned under water	ejected softly just before water impa sank for 5 sec came up OK hissed be	Hissed before impact & deployed at impact, functioned OK								~
	static or Tight Test		=	=	=	=								
	Delay (sec)	6.8	6.1	6.1	5.2	4 l			1					_
-	Water or	b	=	=	. =	=								-
	Color Quality	पू पू	=	=	=	=	*********	OK.						_
	Burn Rate in, (sec)	1										;	-	-
	(spuoses)	10	93	95	94	4		functioned	-					_
(5	Weight (gms Burn Time	4	0,	6	6	84		func	-		·			_
(8	Weight (gms First Fire	2	=	=	=	=		off 5				-		_
ι	Reditives	, ,	=	=	=	=	_	out						_
no	Other							4					-	
ositi	Coolants	-3						ion:						
dwo	Secondary Oxidizer	400 400	`=	=	=	=		Conclus						
nt C	Binder	30	=	=	=	=		Con						-
Percent Composition	muisəngsM	20 G18	=	=	=	=								-
Ъ	Nitrate	25	=	= ,	=	=								-
	Test Date	8/6	8/6	8/6	8/6	8/6								1
	Serial TedmuN	25.8	256	25.7	258	259								-

1. New ogive

2. New bodies

3. New delays (120 batch)

4. New first fire (ingre. unscreened - screen final mix screened 20 mesh method Purpose of tests: check out effect of first fire processing on sinking problem

								· .	0)	Sa
									pove	water
						t;		-		ng v
	good loud ejection; full range; functioned ok	Same as S/N 260	same as S/N 260, except seam split in ballute	same as S/N 260	same as S/N 260	loud, ej, at wat	same as S/N 265	ej, just slag, ej	ejected y-no ball	full range ej. loud, ejected just above slag ejected easily no ballute flaming flame very intense
	1 1	=	=	=	= -	=	=	=	=	=
Delay (s	5 to	=	=	=	=	5.0	5.0	4. 2 snd	5.0	no data
Watero	>	=	=	=	=	=	=	Ξ	=	=
Color	cod	=	=	=	=	=	=	Ξ	=	int
sas/ ui)	1									-
(seconds		=	=	=	=	84	06	95	95	98
) Jugis W			=	=	=	=	=	:	=	=
) Jagis W	0	=	=	=	=	=	=	=	=	=
Additive										
	-									
Seconda	20 PB0,	=	=	=	=	=	=	=	=	=
	1	=	=	=	=	=	=	=	=	=
Magnes	20	=	=	=	=	=	=	=	=	=
Nitrate		-	=	=	=	=	=	=		=
			11/6	3/12	1/11	3/12	3/12	3/12	3/12	269 9/12
Number			01			10			~	6
	Tast Date Nitrate Magnesi Seconda Seconda Conpos Weight ( First Fi Weight ( First Fi Surn Ra (in, /sec	Weight (Sood loud ejection; 1ull Sood eje	Test Date  Titrate  Mitrate  Mitrate  Meight (Seconds Weight (Seconds Weight (In.) Seconds (In.) Sec	Test Timeste Magness Timeste Magness Timeste Magness Timeste Magness Mitrate Coolants Compos Weight Conditive Burn Ra (in. /seconds	Tate of the standards o	Table   Same as S/N 260   Sa	The state   The	The property of the property	1   1   1   1   1   1   1   1   1   1	9/11

Conclusion: All units functioned ok - unscreened ingreds apparently solved sinking problem, however 4 units had broken seam stiching

### 40MM FLOATING FLARE FLIGHT TEST SERIES

1. New ogive

2. New bodies

New delays

First fire (teflon unscreened) (mix screened)

S /N 275-279 batch No. 1 S/N 270-274: hatch No. 5. repacked ballutes 6. batch No. 1 S/N 2

78		10	md .	5.						H. H		
			loyed	ed	ц		•	ove	not	ente sec	fore	port, sink
tests: Green batch qualification		Configuration and/or Remarks	small low sound before impact deployed underwater, came up full range; floated ok; functioned ok	full range, soft ejection, hole burned in top, functioned ok	full range; sank; came up; floated on side; soft ej; functioned ok	full range, med. loud ejection, did not sink, functioned ok	full range, loud ejection; did not sink, functioned ok	slightly short range; ejected just above water, sank, came up, functioned ok, med. foud report, on ejection	full range; ejected above water, did n sink, functioned ok, med loud report on ejection	full range, ejected just above water, enter water sideways, sank, came up in 50 sec. put stayed on side, med loud report, split	slightly, short range, ejected just before impact, med loud report, sank, came up. functioned ok	full range, ejection normal loud report, came in burning hot flame, did not sink, functioned ok
sts: G		Static or Flight Test		ं : स	ft s:	म म	ft.	=  S  ⊗ H	= 1	- -	: S.	26.55
f te			9.9	.5	, 0	2	1	<sub>1</sub>	2	П	3	3
e 0		Delay (sec)		ທີ	5	r,	5.	, ru	r,	7.	r.	5.
bos.		Wateror		11	=	=	-	=	=	=	=	=
- Purpose of		Color Quality	good	=	=	=	=	Ξ	=	=	=	=
- 1		(in. /sec)	90 cm								_	-
279		Burn Rate						-				
N 275-279		Burn Time. (spropse)	95	85	100	06	92	87	93	95	90	92
7	(5	Weight (gms	14	=	=	_	_	_	_	_	_	
S	( 9	Weight (gms First Fire	2					-	-			
2		Composition	9	=	=	=	=	=	=	=	=	=
No		reht O resvitibb A						_				
tch	tion	Coolants										
ba	008	TesibixO	3								-+	
274	Juic	Secondary	40 40 75	` =	=	=	=	=	=	=	=	=
02:	nt Co	Binder	30	=	=	=	=	=	=	=	=	=
S/N 270-274; batch No.	Percent Composition	mnizəngsM	20 G18	=	_ =	. <b>=</b> ·	=		=	=	=	=
-	D.	Nitrate	25	=	=	=	=	=	=	=	=	=
No.		Test Date	9/13	=	=	=	=	=	=	=	=	=
batch No.		Serial Number	270	271	272	273	274	275	276	277	278	279
5.							+	-				

8 out of 10 functioned ok - 1 from each batch floated on sides (probably ballute seam failure) S/N 277 had small hole during assembly. Both batches ok to use. Conclusion:

seam,

40MM FLOATING FLARE FLIGHT TEST SERIES

1. S/N 280-284 repack ballute; S/N 285-289, new ballutes

DATA SHEET

2. New cases

3. New ogives

4. First fire (teflon unscreened) (mix screened)

5 New delays

Green batch qualification

		и										10	1
		Configuration and/or Remarks	Slightly short range;ej. on water;sank, came up, couldn't ej. slag, burn short	range; ej. just above water, did functioned ok, ej. slag ok, med report,	Full range; ej, above water, did not sink, med loud report, ej, slag easily, functioned ok,	Full range; ej. above water, spiralled in; did not sink, ej. slag; functioned ok,	Slightly short range, ej. above water, did not sink, med loud report; ej. slag, functioned ok,	1:	Slightly short, range, ej. above water, did not sink, med loud report, ejected slag, functioned ok,	200	Slightly short range; ejected above water low report, no flame, sank on impact burned underwater.	Slightly short range, ejected above water loud report, flame before impact, did mot sink, vented before slag ejection at low	sure, functioned ok.
-	N.	Static or Flight Test	ഥ	±	=	=	=	=	=	=	=	=	
-	The state of the s	Delay (sec)	5.2	5,3	4.2 snd	4.3 snd	5.1	4.6 snd	5.0	4.7	4.7	4.8	1400
T		Water or Land Test	M	=	=	=	=	=	=	=	=	=	040
-		Color Quality	good	=	=	,=	=	=	=		1	good	- 140
-		Burn Rate (in, /sec)	- An										do b
-		Burn Time (seconds)	89	89	92	85	89	87	85	06	100	92	unnod about.
u l	(s	First Fire Weight (gm	1	=	, =	=	=	=	=	=	=	=	0,00
catic		Composition Weight (gms	0		=	=	=	=	=	=	=	=	
12111		Other Additives									-		0 20
cn di	ition	Coolants											10:40
n bat	sodu	Secondary	200 100 100	` =	=	=	=	=	=	=	=	=	0 6117
Green batch qualification	Con	Binder	30 A	=	=	=	=	=	=	=	=	=	out of 10 functioned of
sts:	Percent Composition	muizəngsM	20 G18	= ,	` =	=	=	=	=	=	=	=	4110
of tes	Pe	N itrate		=	=	=	=	=	=	= .	=	=	t
laso		Test Date		_	_	=	=	=	=	=	=	=	- Judion
Purpose of tests:		Serial	0	281 "	282. "	283	284	285	-	287	288	-	1
Ľ			1 ,4						1	1			1

Conclusions: 8 out of 10 functioned ok. One burned short; one sank.

Post test results: S/N 280 chimney full of slag; S/N 281 284 285 287 ballute ok; S/N 286, 289 1/2 inch break in

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40MM FLOATING FLARE FLIGHT TEST SERIES	
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			×		•	••		ked	ຜ			,	κ.
	New ogives first fire (teflon unscreened) (mix screened) New delays rpose of test: Green batch qualification	full range; ejected at water impact soft ej; flew back into air & functioned ok	slightly short range; no report atej. did not sink, could not ej. slag,	full range; soft ej; above water; flamed good during decent; did not	slightly short range; of above water; soft report; flame good during decent; did not sink; ej. slag; functioned ok	slightly short range; ej, above water; loud report; flame good during decent; did not sink; ei, slag, functioned ok	full range; ej. aboye water; did not sink; med report; flame good during decent, ej. slag; functioned ok	slightly short range; very soft eismoked coming in, ej. at water impact, did not sink; functioned ok; ei. slag.	slightly short range;ej. above water; med report;laid on side but flame was visible some times	Full range; ej, above water; loud report; did not sink; flame good during decent; functioned ok	slightly short range;ej, above water; did not sink; loud report; flame good during decent, ei, slag, functioned ok		full range;ej. just above water; sank; burned under water
	flon (	St:	=	=	=	=	=	=	=	=	=	=	=
New ballutes New bodies	gives ire (tef elays of test:	2. 6	5.2	7,	5.1	4.1 snd	5.0	5.1	5, 1	5.0	4.8	5.0	4.8
New ballute New bodies	New ogives first fire (t New delays	M >	=	=	=	=	=	=	=	=	=	=	=
	7-	0 8 60	=	=	::	=	į.	=	=	=	=	=	= 1
1.	w 4, rv, tr	Ja Ti)			· ·								
	econds)	o Br	9	95	26	98	93	88	105	96	87	98	16
(	irst Fire eight (gms	1 7	=	=	=	=	=	=	=	=	=	=	=
	noitisoqmo enght (gms	M		=	= '	=	=	=	=	=	=	=	=
-	rher sevitibb											7	
sition	sansloo	C				7.0							
Percent Composition	Scondary	O S 2 4 4 0 4 0 4 0 4 0 4 0 4 0 4 0 4 0 4 0	=	=	=	=	=	=	=	=	=	=	
ot Co	rəbni	30 B	_=	=	=	=	=	=	=	=	=	=	=
Prcer	muizengs	20 G18	=	=	=	=	=	=	=	=	=	=	=
Ъ	itrate	Z5 N	=	=	=	=	=	=	=	=	=	=	=
	est	T 2	=		=	=	=	=	=	=	=	=	=
	erial rədmu	N o	291	292	293	294	295	962	297	298	299	300	301

Conclusion: 10 out of 12 functioned ok, one burned short; one sank.

Post test results; S/N 291, 292, 293, 296, 298, 300 ballute ok; S/N 294, 297, 299 1/2 inch break in seam; S/N 295 part of inner seam broken

## 40MM FLOATING FLARE SPECIAL TEST SERIES 1. No ballute

2. Quickmatch ignited

3. Static test in flare tunnel

DATA SHEET

4. All green units

Purpose of Tests: Evaluated effect of plated chimneys on color quality

			,		-				,
		Configuration and/or Remarks	Zinc plated chimney, no effect detected, functioned ok,	Cad plated chimney. No effect detected functioned ok	Nickel plated chimney. No effect detected, functioned ok,	Zinc plated chimney. No effect detected, functioned ok,	Cad plated chimney. No effect detected, functioned ok,	Nickel plated chimney. No effect noted, functioned ok.	
1000		Static or Flight Test	I (1)	=	=	=	=	=	
farmat .		Delay (sec)				- 4			
		Water or Land Test	×	=	=	=	=	=	
- 4		Color Quality	intense	=	=	=	=	=	
- (		Burn Rate (in, /sec)							
		(seconds)		0		3	3	94	
	(s	Weight (gms	/4 88	90	91	93	93	6	
4	10	Weight (gms First Fire	2	=	=	=	=	=	
		onsitisogmo Meisbl dais W	9	=	=	=	=	=	
0 0 0 0 0		rədtO RaditibbA							
	ition	Coolants			7				
5000000	sodu	Secondary	4 P	=	=	=	=	=	
	t Cor	Binder	30	=	=	=	=	=	
-	Percent Composition	muisəngsM	~	=	=	=	=	=	
	Pe	Nitrate	25	=	=	=	=	= -	
		Test Date		=	=	=	- =	=	
T		Serial Number	3029/20	303	304	305	306	307	
-									

. #

Conclusion: The type of plating doesn't affect the color quality of the green flare.

#### TEST SERIES 40MM FLOATING FLARE FLIGHT

Mills ballutes no. 40 thd

New ogives New bodies

3

New delays 4 Wind blowing

Serial

313-317 vellow 6. S/N 308-312 red

DATA SHEET

Purpose of tests: Red & Yellow batch qualification against direction of flight

Full range el above water, med to loud report, good flame during decent, did not sink, functioned ok. low to med ok. Full range, ej, above water, med loud Seport, Good flame during decent, burned Full range, ej. above water, spirled into water, sank, came up, chuffed, sank. Full range; ej. just above water, weak report, floated ok, functioned ok, Slightly short range, ej. above water, low report, sank on impact, came up, floated ok, functioned ok came 50 Slightly short, ej. above water, low report, tumbled decent, burned ok functioned ok, Full range, ej. above water, med to loud report, good flame on decent, innctioned off. Full range, ej, aboye water, med to loud report, good flame on decent, intense flame, functioned ok, slag, functioned ok. Full range, ej. on water, sank, Full range, ej. above water, report, floated ok; functioned and/or Remarks Configuration up, no ej. of, Full Flight Test = = H = = = = = = = Static or 5.3 5,3 5.2 5.5 2 5.1 7 3 5,3 5.2 2 2 Delay (sec) 5 Land Test . .. -: : = = = = TO Tate W Quality ntense dim red yel. = = = = = = = = Color (Ses/ ·ui Burn Rate (spuoses 89 100 82 62 78 100 92 81 91 26 (swg) 2/4 Weight = = = = = = = = = Fire First Weight (gms) 89 = = = = 09 = = = = Additives Other Percent Composition Coolants AP 50% Oxidizer 50M = = = = = = = = Secondary Binder 25 = = = = = = = = = 224 22 M Magnesium = = = = = = = = Vitrate 40 = = = = 45 = = = 45 308/9/20 Date Test = = = = = = = = = 315 317 309 310 312 313 314 316 Number 311

Red units - 1 unit had large hole burned in top of ballute. 4 out of 5 functioned ok. 2 Conclusion:

yellow units out of 5 functioned ok.

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1. Mills ballutes
2. New bodies
3. New ogives
4. Same first fire as 9-20-72
5. Most wind of any previous test day.

8. S/N 318-321 green S/N 322-326 Red S/N 327-329 yellow

Orifice used in chimney

DATA SHEET

	ts.										>	·			8
	ballute with green, red & yellow qual units		Full range, ej. just above water, sank, came up. functioned ok.	Full range, ej, above water, loud report sank, came up, floated ok, difficulty in slag election, functioned ok.	Full range, ej. above water, sank, came tup, loud report, trouble in slag ejection	Full range, ej. above water, loud report, did not sink, slag ej. normal, functioned		Full range, heard soud just above impact no ejection, no burn.	Slightly short range, ej, at water impact floated ok, functioned ok,	Full range, ej. above water, low report	full range, ej, above water, low report functioned ok, flame went out, temporarily	Full range, ej. above water, loud report spirled during decent, did not sink, functioned ok,	Full range, ej. above water, med loud report, sank, came up, functioned ok,	Full range, ej. just above water, sank, burned under water, came up near end of burn, floated on side, med loud report	
1111	Oneck out Mills	Static	1	[z <sub>1</sub>	Ŀı	Į	Ĺ	[I4	Ĺτι	Ĺų	ഥ	দ	Ĺτι	[H	
1	one I	Delay	5.5	5,2	5, 1	5, 1	5.2	5, 1	5.0	5, 1	5,3	5, 2	5.2	5, 1	
1000	Je C K	Water	×	×	W	M	M	M	M	M	M	M	M	<b>A</b>	-
	-	Color	int	=	=	. =		ı	good	=	=	int yel.	=	:	
00400	DIT	Burn (in./s			3 -				w H			^			
T JO	5	(secon	101	94	95	92	62		82	85	83	95	86	85	
DORO	חום ביי	First Weigh	4	=		=									-
Purno	וו	Weigh				1	= 00	-	=	=	=		=	-	
day.	i.i	Other Addit Comp	09	=	=	-	89	=	=-	=	=	9	=	=	, , ,
מ	I.	Coola													-
enor.	Z	Secon	25 AP 400%	=	=	=	50% 50%	=	=	=	=	45 50 50	=	=	1 3
7.	I	9 <b>bni</b> A	30	=	=	=	25	=	=	=	=	=	= 1	=	7
deburred	Э	mgsM	-3	=	- =		22/2	=	=	=		15 22M	=	=	*
ebur	<b>3</b> 4	Nitra	25	25	25	25	40	40	40	40	40	45	45	45	
		Test Date	12/	=	=	=	=	=	=	=	=	=	=	=	
Bodies		Seria	3189/21	319	320	321	322	323	324	325	326	327	328	329	2
4															

Conclusions:

4 out of 4 green functioned ok (1 sank, 1 dud) 3 out of 5 red functioned ok (1 sank, 1 dud) 2 out of 3 yellow functioned ok (1 floated on side)

40MM FLOATING FLARE FLIGHT TEST SERIES

Same data as previous units

	Configuration and/or Remarks	Full range, ejected above water, med, loud report, did not sink, functioned ok,	Full range ejected above water, low report did not sink good flame during decent, functioned ok,	
	Flight Test			
	Static or	<u> </u>	=	
	Delay (sec)	5.4 F	= -	
	Water or Land Test	×	=	
	Color Ouality		=	erio (di
	(in. /sec)			
	Burn Rate			
	(seconds)	00	95	
	Burn Time	100	6	
(s	Weight (gm	/4	=	
	First Fire	2		
	Composition Graphs (gm.)	09	=	
	Additives	- 6		
	Other			
ition	Coolants			
soc	Oxidizer			
mp	Secondary	15 AP 50/	=	
ıt Co	Binder	25	=	
Percent Composition	Magnesium	15 22µ	=	
P	N itrate	45	=	
	Test Date	330 9/21 45	=	
-	Number	6		
	Serial	330	331	

Conclusions: 2 out of 2 yellow units functioned ok

<sup>1.</sup> S/N 330, 331 yellow 2. S/N 330, 331 cont. of test of S/N 327, 328, 329

S/N 332, 333 lab static tests S/N 332, 333 from same lot as S/N 322-326

DATA SHEET

40MM FLOATING FLARE SPECIAL TEST SERIES

FIND OUT WHY RED FLAME OUT OCCURRED IN FLIGHT TESTS PURPOSE OF TESTS:

Static test lab red burned normally Static test lab red burned normally and/or Remarks Configuration with a stand off flame with a stand-off flame Flight Test = S Static or Delay (sec) Land Test Water or Quality × = Color (in. /sec) good = Burn Rate (seconds) 86 62 Burn Time Weight (gms) 2/4 = First Fire (smg) thgie W 89 11 Composition Additives Other Percent Composition Coolants Oxidizer 30 AP 50 M Secondary = Binder 22 N 25 = = Magnesium Nitrate 40 = Date 17/6 = Test Number 333 332 Serial

Conclusion: Mix appears OK but batch rejected anyway due to poor flight tests - all mix ingred will be dried overnight and new candles of red made tomorrow,

40MM FLOATING FLARE FLIGHT TEST SERIES

1. Reused ballutes made by Chemtronics

2. New green bodies

3. Ingr. dried overnight 4. Delays (AAI)

RESTS: Red batch qualification

						d	
		Configuration and/or Remarks	Fired high OE deployed high-med loud report-stable on decent, full balluate functioned OK	Hex delay-fired high OE dployed high, soft ejection, stable on decent, full ballute-functioned OK	High QE, deployed at max altitude-soft ejection unstable decent sank on impact	Med high QE; deployed high;med ejection report; stable decent hit ground, threw into water, functioned ok, full ballute	
		Static or Flight Test	Гч	=	=	=	
		Delay (sec)	6.1	5.2	5.0	4.9	
			9	72	5	11	
		Water or Land Test	W	=	=	J ≽	
		volov Ouslity	good red W	=		good L red W	
		(in. /sec)					
7		Burn Rate					
		(seconds)	75	74	09	92	
tion	(s	Weight (gms emiT nrud	7				
cat	,-	First Fire	2/4	=	Ξ	=	
ifi	(s	Weight (gm					
ıal		oitisogmo	89	=	Ξ	=	
Б		Additives					
tch	u	Other					
d ba	sitic	Coolants					
Re	odı	TesibixO	50 AP	=	=	=	
•••	on	Secondary	υ4π				
STS	nt C	Hinder	25	=	=	=	
F TE	Percent Composition	muisəngsM	22K	=		=	
PURPOSE OF TESTS: Red batch qualificat	Ъ	Nitrate	40	=	=	=	
502		TesT Date	9/23	=	=	=	
K	<del></del>	Number	6	2	9	-	
P		Serial	334	335	336	337	

1 sank on impact - probable cause - hole burned in ballute 3 out of 4 functioned OK

40MM FLOATING FLARE SPECIAL TEST SERIES
Purpose of Tests: check out new red mix for longer
duration, also double first fire charge.

	1	1	T			
	- 5					
		Configuration and/or Remarks	Lab static test	functioned ok	Lab static test, burn thru cannister near end not in deep enough water.	
		Static or Flight Test	-	S	=	
		Delay (sec)	-	_		
		Land Test	_			
		Water or		×	=	
		Color Quality	int.	red	=	
	-	(in. /sec)				
		(seconds)	-	_		
		Burn Time		81	4 91	
	(5	First Fire Weight (gm	4/	0	4/4	
	(5	Weight (gms		-		
	U	Composition		62	99	
		Other Additives				
	ition	Coolants				
	200	TezibixO		3		
	oml	Secondary	25	4	=	
	nt C	Binder		(25	=	
	Percent Composition	muisəngsM	10	3504	=	
	Д	Nitrate		40	11	
		Test Date	1	9/30	=	
-		Number		338 9	339	
- [		Serial		2	3	

Conclusion: New composition appears to increase burn time of red unit, No problem with double first fire

#### APPENDIX G

PHASE II DEVELOPMENT AND QUALIFICATION TEST DATA

# 40MM FLOATING FLARE STATIC & FLIGHT TEST SERIES

2. Bodies dried at 1150F for 72 hours 1. All new parts

3. Mix components dried at 160°F for 24 hours

PHASE II DEVELOPMENT AND QUALIFICATION THEFT TOURS

APPENDIX G - 40MM FLOATING FLARF

PURPOSE OF TESTS: PHASE II GREEN QUALIFICATION

						, t							39
	Configuration and/or Remarks	Ejected OK, hole in ballute	Functioned OK	Functioned OK	Functioned OK	Did'not eject slag ballute seam split,	Functioned OK	Ejected underwater, Functioned OK	Functioned OK	Did not eject slag. Ballute seam split	Did not eject slag. Ballute seam split	Did not eject slag, Ballute seam split	The second secon
	Static or Flight Test	ĹΉ	# 0.r	=	=	=	=	=	=	=	=	:	-
	Delay (sec)	OK	=	=	=	=	=	=	=	=	Ξ	=	-
	Water or Land Test		11	=	=		=	=	=	=	=	11	-
	Color Quality												1
	Burn Rate (in, /sec)												1
	Burn Time (seconds)	09	98	88	88	45	85	85	98	50	40	71	 -
(8	First Fire mg) Jhgie W	3/4	=	=	=	=	=	=	=	=	=	=	1
	contisogmoO smg) Jugie W	65	=	=	=	=	- =	=	=	=	=	=	
	Other sevitibbA												
ition	Coolants				1								
Composition	Secondary Oxidizer	P.001	=	т,	- =	=	- 1	=	=	=	=	=	
t Cor	Binder	30 4	=	=	=	=	=	=	=	:	:	=	1
Percent	muisəngsM	350	= ,	=	=	=	=	=	=	=	=	=	
Pe	Nitrate	25 3	=	=	=	=	= ,	=	=	=	-	=	1
	Test Date	12/11	=	=	=	=	=	=	=	=	=	=	
	Serial Number	340 L	341	342	343	344	345	346	347	348	349	350	 -

# 40MM FLOATING FLARE STATIC & FLIGHT TEST SERIES

2. Bodies dried at 115°F for 72 hours 1. All new parts

3. Mix components dried at 160°F for 24 hrs and assembled warm

4. 1/2 of units taken from initial assembly and 1/2 taken at random

DATA SHEET 6. All green units.

5. Polyethylene chimney insert full length of chimney

Purpose of tests: Phase II green qualification and to check out new chimney insert design during assembly.

90			٠						S		**		
	Configuration and/or Remarks	slag buildup in chimney. Insert ns away in 10 to 12 sec. Eunctipped	as S/N 351	as S/N 351	No slag buildup in chimney. Functioned OK	Same as S/N 354			Conclusions: 3 static tests	will he			
		No sla burns	Same	Same	No sla Functi	Same	Same	Same	Same	Same	Same	Same	Same
	Static or Flight Test	ß	=	=	ĹΉ	= -	= .	=	=	=	=	=	= '
	Delay (sec)		1.	ı	OK	=	. =	=	=	=	=	=	=
	Water or Land Test	W	_	=	=	<u>:</u>	<u>:</u>	= 1	=	"	=	=	=
	Color Quality	grn	=-!-	=	.=	=	=	= 1	=	=	=	=	=
	Burn Rate (in./sec)								-				
	Burn Time (seconds)	88	89	98	85	06	88	87	88	88	85	85	98
7	First Fire (gms)	3/4	=	<b>11</b> (2.42)	=	=	=	=	=	=	=	=	=
	noitieoqmo Reng) thgie W	65	=	=	=	=	=	=	=	=	=	=	=
	Other sevitibb A			7									
itior	Coolants					4.		12.76					
npos	Secondary	000 000 000 000 000	=	= _	7.7	=	=	=	=	=	=	=,	=
Cor	Binder	30 4	=	=	=	=	=	=	· =	=	=	=	=
Percent Composition	muisəngsM	350	=	=	=	=	Ξ	=	=	=	=	=	=
P	Nitrate	25	=	=	· =	· =	=	=	= ,	=	Ξ	=	=
	Test Date	12/14	=	=	=	=	=	=	=	=	=	= ,,	=
	Serial Number	351	352	353	354	355	356	387	358	359	360	361	362

Conclusions: 3 static tests showed that a full length insert Will Kelp the slag problem in the chimney.

All new parts

Bodies dried at 115°F for 72 hours

DATA SHEET

3. Mix components dried at 160°F for 24 hours
4. 1/2 of units taken from initial assy and 1/2 taken at random during assy.
5. Full chimney length insert used
5. Full chimney length insert used
6. S N 363 green unit; S/N 364-373 red units

ition		Configuration and/or Remarks	)	illdup in chimney,				Conclusions:	10 out of 10 green units functioned OK with full	length chimney inserts. 10 out of 10 red units	length chimney inserts.		9	01
Phase II Red qualification			5	No slag buildup Functioned OK	Same	=	=	=	=	=	=	=	=	=
II R		c or	Stati	ᄕ	=	=	=	=	=	=	=	=	=	=
lase		(sec)	Dela	OK	=	=	=	=	=	=	=	=	=	=
- 1		r or dest		M	=	=	Ξ	=	=	=	=	=	=	=
Purpose of tests:			Colo	grn	red	=	=	. =	=	=	=	=	=	=
e of		Rate (sec)	.ni)											
rpos		a Time (abno	sec)	88	98	87	98	88	88	85	89	88	68	85
Pu	(8	ght (gms	Wei	3/4	=	=	:	=	=	- =	=	=	=	=
1		oitieoqu ght (gms	Wei	65	=	:	=	=	= 1		=	=	=	=
units		seviti	-											
red unit	sitio	lants				ă-								
364-373	Composition	ndary lizer	Seco Oxio	25 ABO	25 AP 504	=	ш	=	=	=	=	=	=	-
364		1	Bind	30	25	. =	= ,	=	=	=	=	=	=	=
S/N	ercent	unisəu	Mag	350	350	=	~	=	=	=	=	=	=	=
green unit;	P(	ete.	n it r	25	40	=	=	. =	=	=	=	=	=	=
eén			Tes	12/14	12/18	=	=	=	=	-=	=	=	=	=
363 gr		ial nber	Seri	363	364	365	366	367	368	369	370	371	372	373

Purpose of Tests: Phase II yellow qualification 40MM FLCATING FLARE FLIGHT TESTS SERIES

1. All new parts

. Bodies dried at 115°F for 72 hours

3. Mix components dried at 160°F for 24 hours and assembled warm

4. 1/2 of units taken from initial assy and 1/2 taken at random during assy

Full chimney length insert used Lake covered with 1/2"-1/4" thick ice.

7. S/N 374-381 yellow units; S/N 382 red unit 8. Chimney attached by 3 crimp rolls

		-									
	Configuration and/or Remarks	No slag buildup in chimney Functioned OK	Same	Same	Same	Same	Full range Functioned OK	Same	O-ring tried on chimney/cannister	Full range - went under ice	
		1 1 .	=	=	=	=	=	=	=	=	+
2	3	OK	=	=	=	=	-=	=	=	=	+
			=	=	=	=	=	=	=	=	$\dagger$
in-	VillanC	-	2	- =	=	11 <b>2</b> 1	=	100	=	P,P	+
	(in. /sec)								$\vdash$	H	$\dagger$
·	Burn Time (seconds)	86	66	103	66	101	86	66	103	88	$\dagger$
(5		3/4	=	=	=	Ξ	=	=	=	=	t
	Weight (gms	56	=	=	Ξ	=	=	=	=	672	t
											-
sitio	Coolants			-		-					
odwo	Secondary Oxidizer	15 AP 50%	=	11	Ξ	=	=	=	- =	25 50%	
nt Co	Binder	25	=	11	=		=	=	=	215	
erce	muisəngsM	15 22,4	=	=	=	=	=	Ξ	=	10 350	
Ъ	N itrate	45	11	, n	=	=	=	=	=	40	•
	Test Date	12/20	=	11	=	=	=	=	=	E.	•
	Serial rodmuN	374	375	376	377	378	379	380	381	382	
	(5	Mumber Test Date Magnesium Magnesium Binder Coolants Coolants Weight (gms) First Fire Weight (gms) Weight (gms) Weight (gms) Weight (gms) Weight (gms) First Fire Weight (gms)	Percent Composition  Variette Number  Variette Nather  Nather  No slag buildup in chimney  Number  Composition  Additives  Configuration  Configuration  Static  Configuration  Additives  Configuration  Static  Configuration  Additives  Configuration  Static  Configuration  Additives  Configuration  Static  Configuration  Additives  Configuration  Additives  Configuration  Configuration  Additives  Configuration  Additives  Configuration  Additives  Configuration  Additives  Configuration  Additives  Configuration  Configuration  Additives  Configuration  Additives  Configuration  Additives  Configuration  Configuration  Additives  Configuration  Configuration  Configuration  Additives  Configuration  Configuration  Additives  Configuration  Configuration  Configuration  Additives  Configuration  Configura	Percent Composition  Test  Test  Date  Nitrate  Nitrate  Nitrate  Nitrate  Nitrate  Configuration  Additives  Coolants  Coolan	Percent Composition  Number  T est  T est  Dates  Ditrate  Nitrate  Nitrate  No slag buildup in chimney  Same  Same  Same  Same  Same	The factor of th	Test Composition  Test Date  Test Configuration  Test Date  Test Color  Test Colo	Percent Composition   Percent Composition   Percent Composition   Date   Date	Percent Composition	Percent Composition   Percent Configuration   Percent Configuration	Percent Composition

8 out 8 yellow units functioned OK with full length chimney insetts l out of l red unit functioned OK with full length chimney insert Conclusions:

#### APPENDIX H

PHASE III DEVELOPMENT AND QUALIFICATION TEST DATA

1. All Green Units

-2. First Fire 19.2B, 18.2 Teflon, 57.6 KNO3, 5 Binder APPENDIX H - 40MM FLOATING FLARE - PHASE III DEVELOPMENT AND OUALIFICATION TEST DATA

Percent Composition	ON TEST DATA		on .rks	delay spit; no ire,no ejection			ejection .	seen, no ejection			Ejection slow			unctioned OK	tted in,
1				Delay glow transfer to	Functioned		glow seen,	glow	Functioned OK		OK -	Functioned OK	Functioned OK	Ejected under H <sub>2</sub> O	Ignition transfer, jono ejection
1	ENT				= =	=		=	=	=	:	=	Ξ.	:	=
1	OPN			Dud	OK	=	Dud	11	OK	· =	ü	=	=	=	=
1	VEL				=	11	=	11	=	=	=	Ξ.	Ξ	=	= ,
1	C DE		Color	1	OK	<u>.</u>		1	OK	=	E	=	Ξ	=	
1	EII						150.0								
1			(seconds)		89	88	1	. 1	83	85	83	87	87	93	
1	1	(5	weight (gms	3/4	=	=	=	=	=	=	=	=	=	=	=
1	LARI	( s	Weight (gms		=	=	=	=	=	=	=	=	=	=	=
2/2 Test    PENDIX   Patent	H		Additives												
2/21 Test PENDIX H - 40MM PEND	ATIN	sition	Coolants				7								
2/21 Test PENDIX H - 40MM PEND	FLO.	mpos	Secondary Oxidizer	45 400	- =	=	=	=	=	Ξ	=	=	=	=	=
2 7 7 Test Date Date Date Date Date Date Date Dat			Binder	30	=	=	=	ш,	=	=	=	=	=	=	=
2		rcer	muisəngsM	20 350	=	=	=	=	=	=	=	=	=	=	=
III I I I I I I I I I I I I I I I I I	IX H	P.	P07		=	=	=	=	=	. =	=	_=	=	=	=
III I I I I I I I I I I I I I I I I I	END		TesT	2/21	=	=	=	=	=	=	=	=		3/1	=
	APP	8		2	384	385	386	387	3.88	389	390	391		93	394

1. All green units 2. S/N 395-400 std. first fire 3. s/n 401-405 first fire teflon reduced 25%

QUALIFICATION TEST DATA		Configuration and/or Remarks	Functioned OK	Funcioned OK	Functioned OK	Ignition transfer, jetted in, No ejection	No ignition, Dud	No ignition, Dud	Ejected and burned under water	Functioned OK	Jetted in, ejected and surfaced 20 sec	Jetted in, ejected and surfaced 10 seconds later.			
LIF		Static or Flight Test	I -	=	=	=	=	=	=	=	Ξ	=	Ξ		1
QUA		Delay (sec)	V	=	=	=	Dud	Dud	ÖK	OK	=	=	=		1
AND		Water or Land Test	>	=	, =	=	=	=	=	=	=	=	=		1
LN		Color Quality	X	-=	=	1	. 1	,	,	OK	=	=	=	,	1
DEVELOPMENT		(in, /sec)		4											1
[O]	-	Burn Rate	2	06	92					89	69	62	89	-	+
EVE	(5	Weight (gms Burn Time		6	6	- I	'	'		- 80					-
III D		Weight (gms First Fire	3	=	=	= '	=	, E	=	=	=	=	=		1
	7	Composition	9	=	=	=	=	=	=	=	=	=	Ξ		
PHASE		Other Additives													
	itior	Coolants													1
FLARE	Composition	Secondary	435 4004	=	=	=	=	=	=	=	=	=	=		1
		Binder	30	=		=	=	=	=	=	=	=	=		
FLOATING	Percent	muisəngsM	350	=	=	=	=	=	=	=	=	=	=		1
FLO.	P	Nitrate	25	=	:	=	=	=	=	=	=	=	=		
40MM I		Test	3/1/	Ξ	=	3/5/	- <sub>10</sub> =	=	3/6/	=	=	=	=		1
40		Serial Number	3,65	396	397	398	399	400	401	402	403	404	405		-
		The second name of the second na	_		The second named in column 2 is not a second										

and the second s

<sup>1.</sup> All green units
2. S/N 406-408 No teflon in First Fire
3. S/N 409-413 First Fire in Teflon reduced 75%
40MM FLOATING FLARE - PHASE III DEVELOPMENT AND QUALIFICATION TEST DATA

			-					-					1000	
ALMU LEST MOLLE		Configuration and/or Remarks	Functioned OK, ejected very hard, sank immediately after burn out.	Functioned OK, same as 406	Functioned OK, same as 406	Functioned OK, good ejection	No ignition of delay, no glow seen	Functioned OK, good ejection	Functioned OK, good ejection	Functioned OK, good ejection				
101		Flight Test		=	=	=	=	=	=	=		-		
		Static or	M				Dud	×				-		
707		Delay (sec)			=	=		OK	=	=				
AND CORDIE IOA 1101	Water or Land Test		W	Ξ	=	=	Ξ	=	=	=				
		Color Quality	OK	_	-	<u>-</u>		OK	=	)A	Spirit of	Billey we		6.000 (C)
VELOFMENT		(in, /sec)					-					-		
IMI		Burn Rate												
S		Burn Time (seconds)	88	89	87	89	0	89	88	89				
디	(s	Weight (gms	/4				-							
DE V		First Fire	3/	=	=	=	=	=	=	=				
		Weight (gms	64	=	11	=	=	=	=	=				
7 111		Radditives Composition	9					-	-				-	
ADI	ď	тэціО												
FHASE	itio	Coolants												
1	Percent Composition	Secondary Oxidizer	4	-	=	=	=	=	=	=				
FLAKE	Con	Binder	30 4(							-	-			
- 1	ent			=	=	=	=	=	=	=				
LIN	erc	muisəngsM	100 100 100 100 100 100 100 100 100 100	=	=	=	=	=	=	=				
VOA.	Д,	N itrate	25	=	=	. =	] =	=	=	=				
TH		Test Date	3/5/	=	=	=	=	=	=	=				
40MM FLOATING		Number	406 7	407	408	409	410	411	412	413				
4		Serial	4	4	4	4	4	4	4	4				

40MM FLOATING FLARE - PHASE III DEVELOPMENT AND QUALIFICATION TEST DATA 1. All green units 2. First Fire: 67.8 KNO3, 22.6 B, 4.6 Teflon, 5 Binder

					-					+			 	_
		Configuration and/or Remarks	Functioned OK	No transfer to F.F., Delay glow, no spit seen, delay shutdown possible	nctioned O	=		11	=				97	
		Static or Flight Test		=	=	=	=	Ξ	=	=	Ξ	=		
		Delay (sec)	7	Dud	5.0	5.7	5.5	5.4	5.0	5.3	5.2	5.6	<b></b>	1
		Land Test		Ξ	=	=	=		Ξ	Ξ	Ξ	=	<del> </del>	+
		Quality To 1918 W			14								 	+
		Color	O	11	OK	=	. =	=	=	=	=	=		
		Burn Rate (in./sec)												
1	(seconds)			,	85	89	87	87	92	89	87	91		1
+	(5	Weight (gms Burn Time	3/4 9										 	1
		First Fire	3	-	=	=	=	=	Ξ	=	=	=		
1		Composition Smg) tigis W		=	=	=	=	=	=	=	=	=		
ľ		Additives												1
1	on	Other												
1	siti	Coolants												
	odw	Secondary Oxidizer	4°5 400 <b>√</b>	=		=	=	=	=	=	=	=		
	t Co	Binder	30	=	-	=	=	=	=	=	=	=		
	Percent Composition	muisəngsM	350	=	=	Ξ	=	=	=	=	=	=		
	P	Nitrate	25	- =	=	=	=	=	=	=	=	=		
-		Test Date	1	=	=	=	=	=	=	=	=	=		
-		Serial Number	4147	415	416	417	418	419	420	421	422	423		
	-											1	1	

<sup>1.</sup> All green units
2. Samples pulled at random
3. New First Fire

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EVELOPMENT AND QUALIFICATION TEST DATA							ŀ							
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		Configuration and/or Remarks	P											
		an	Functioned OK	Ξ	=									
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IC/														
H		Flight Test		=	=									
AL		Static or		4	0			-	-					
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	Maria	Land Test	Ż	=	=									
	cúltim													
		Villen		_	Ξ	No. of the least o				100	408	girist	erigija in j	511-03
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Mc		Burn Rate												
Q		(seconds)										-	-	
EI	Burn Time		96	=	2									
EΛ	(s	(gmg) Jugie W		_	_									
D	-/	First Fire		-					- 1					
III	ι (ε	Compositioi Smg) Jugie W	64	=	=									
PHASE		Additives									-	-		
HA	_	Other											1	.
	ior	Coolants												
[-]	sit	-,,-	X										,	
RI	odu	Secondary Oxidizer	P. 00	=	=									
LA	Composition											_	-	
H		Binder	30	=	=					-		1	.	
Z	en	IIINI GAII SAIA	3						-	-	-	-		
E	Percent	Magnesium Tebni B	20 35	=	=		, ,							
Q	Б	Nitrate	25	11	,=									
40MM FLOATING FLARE														
Z		Test Date	3/13	=	=		1.0		1				1	
N N		Number								-	-	-	-	
4		Serial	424	425	426					1				
L														

1. All red units
2. New First Fire
40MM FLOATING FLARE - PHASE III DEVELOPMENT AND QUALIFICATION TEST DATA

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	Configuration and/or Remarks	O. A.											
	Coand	Functioned OK							-	=	_	_	
		ctio	=	=	11	=	=	-	-		=	=	
	Flight Test					_	=	=	=		=	=	
-	Static or	1	5 =	3	11 9	- 0		4	0	- 2	m	3	
	Delay (sec)	1 41	5	5.	5.	5.	5.	5.	5.	2	ນ	υ,	
	Water or Land Test		:	=	=	=	=	=	=	=	=	=	
-	VillanD	X						-	. =				
-	(in, \sec)		=	· =	=	= -	Ξ	-	_	=	=	=	
	Burn Rate								У.				
	Burn Time (seconds)		8'4	87	83	98	90	90	90	83	85	88	
(5	Weight (gms		8					=	-				
-	Weight (gms First Fire			=	=	= .	. =		=	=	=	=	
	Somposition W		_	=	=	=	=	=	= -	=	=	=	
	Raditives												
ion	Other								$\dashv$	-	-	-	
sit	Coolants												
mpc	Secondary Oxidizer	25 AP 50 50	=	=	_	=	=	=	=	=	=	=	
Percent Composition	Binder												
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erc	Magnesi	10	=	=	=	=	=	=	=	=	=	=	7
Ц	Nitrate	4	_=	=	=	. =	=	= 1	=	31	=	=	
	Test Date	S COL					3 4	=	=	15/1			
J. 1905.	Number		428"	= 6	- 0		(1)	33		435 3/15/3"	1 9		
	Serial .	427	4	429	430	431	432	433	434	43	436	437	

1. All Red Units 2. New First Fire

tion narks	, <u>i</u>
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A   Range   A   A   A   A   A   A   A   A   A	
DUALIFICATION TEST DATA  DUALIFICATION TEST DATA  Land Test Land Test Configuration  S. 1 F Functioned OK  5. 5 " " " " " " " " " " " " " " " " " "	
五日 Z	
O Static or Flight Test	
ALLIE O O O O O O O O O O O O O O O O O O O	
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(gms) Weight (gms)	
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Coolants Sition Other	
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14	
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1. All yellow Units
2. New First Fire
40MM FLOATING FLARE-PHASE III DEVELOPMENT AND QUALIFICATION TEST DATA

_				-								
												10
	Configuration and/or Remarks	Functioned OK	=	Ξ	Ξ		-11		=	=	11	
	Static or Flight Test	1 -	Ξ	Ξ	Ξ	=	Ξ	=	=	=	=	
	Delay (sec)	OK	=	=	=	=	=	=	=	=	=	
	Water or Land Test		=	=	. =	- =	=	=	=	=	=	
	Color Quality		=	=	=	=	=	* =	=	=	=	
	Burn Rate (in, /sec)											
	Burn Time (seconds)	9	16	97	97	100	+06	=	=	=	=	
(5	Composition Weight (gms) First Fire Weight (gms)		=	=	=	-	=	=	=	=	Ξ	
				=	=	=	-			=	=	
	Other Additives							_		-		
ition	Coolants											
Percent Composition	Secondary Oxidizer	15 10 10 10 10 10 10 10 10 10 10 10 10 10	=	=	11	· '=	=	=	=	=	=	
t Cor	Binder	25 \$	=	=	, =	=	=	=	=	=	=	
rcen	Magnesium	-	=	=	=	:	=	=	=	=	=	
Pe	Nitrate	45	=	- =	. =	=	=	=	=	=	=	
	Test	3/20	=	=	=	=	3/30/	=	- =	=	= '	
	Serial TadmuN	447	448	449	450	451	452	453	454	455	456	

DATA SHEET

1. All yellow Units
2. New First Fire

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		S											
		Configuration and/or Remarks											
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DATA		gu]	M							-			
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ST		Co nd/	Functioned OK			*						1	
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Z			, nc			-							
IO			면면										
AI		Flight Test		=	=	=	=						†
FIC		Static or	F1										1
QUALIFICATION TEST		Delay (sec)		=	=	11							
DO		Land Test				-			1				Ī
		Vality Nater or			=	=	=		 			 	1
DEVELOPMENT AND		Color		=	<u> </u>	=	<u>.</u> .		7.4	ASSET			١
	1	(in. /sec)											1
E		Burn Rate											
PN		(seconds)		93.	91	93	26						
9	(s	Weight (gms Burn Time			- 0.			-	 			 	1
VE.	,	First Fire		=	=	=	=						ı
E		Weight (gms	9										1
H	τ	Composition		=	=	=	=						
H		sevitibb A						1					I
ASI	on	Other					-		 	- $+$		 •	
PHASE	iti	Coolants					460 000		- 1	. ]			
	pos	TazibixO	0.3										
1R	om	Secondary	15 A 50	=	=	=	=						
40MM FLOATING FLARE	ot Co	Binder	25	=	11	=	=						
	Percent Composition	muizəngaM	15 22µ	11.	=	=	=						
OAI	P	Nitrate		=	=	=	_=						
FL		Date							-	-		 	
Z		TesT		=	=	=	=						
MO3		Serial Number		458	459	460	461						
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